

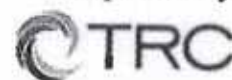
Final Report

Particulate Emissions (PM₁₀, PM_{2.5} and Condensable) and Hydrochloric Acid Emissions Testing at Potomac River Generating Station Alexandria, Virginia

Prepared for:

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December 2006

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1.0 INTRODUCTION

1.1 OVERVIEW

TRC of Lowell, Massachusetts was retained by Mirant Potomac River, LLC (Mirant) to provide sampling and analytical support in completing a Particulate Emission Test Program at the Potomac River Generating Facility. The Test Program at the Potomac facility involved the completion of emissions tests for total particulate matter less than or equal to 10 microns (PM_{10}), particulate matter less than or equal to 2.5 microns ($PM_{2.5}$), and condensable particulate matter. All tests were completed under normal operating conditions while the units tested were maintained at 90% of full load or greater. Additionally, testing was conducted on Unit 3 at the stack outlet for hydrochloric acid (HCl) and hydrogen fluoride (HF) emissions.

The results obtained during this test program support the contention that the use of Trona injection in combination with electrostatic precipitators results in a reduced emission rate of particulate matter. The Trona supplier, Solvay Chemicals, has presented technical papers at various industry forums that describe how electrostatic precipitator efficiency is improved with the use of sodium sorbents (see www.solvaychemicals.us). The principal mechanism for the enhanced performance is derived from the additional sodium present in the fly-ash. With the sodium present, ash resistivity decreases allowing for more efficient particulate matter collection by the electrostatic precipitator.

1.2 SCOPE OF WORK

The test program for particulate emissions was conducted on Units 2 and 3 at the facility. Testing was performed at three locations on each unit. The sampling locations were as follows: the inlet to the hot side electrostatic precipitator (HESP), the inlet to the cold side ESP (CESP), and the exhaust stack of each unit. Testing on each unit occurred with every effort to maintain a 75% SO_2 reduction rate during the test, but in no case did the reduction rate fall below 70% SO_2 reduction. All test runs for Unit 2 were completed with TRONA injection. A series of test runs

were completed for Unit 3 with and without TRONA injection. Table 1-1 summarizes the tests completed on each unit during the test program.

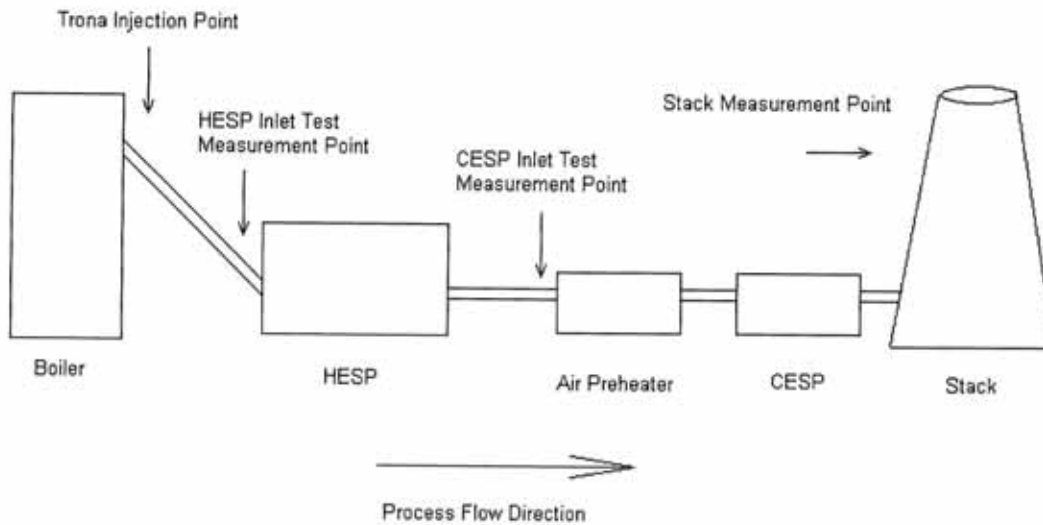
The testing determined the emission rate of particulate matter in terms of the emission standard (lb/MMBTU).

Testing for HCl and HF emissions was conducted on Unit 3 at the stack outlet location.

Table 1-1. Summary of Test Conditions

Unit	Trona	Test Locations	Test Parameters	No. of Test Runs	Run Duration
2	On	HESP, CESP, and Exhaust Stack	PM ₁₀ , PM _{2.5} , Condensable PM	5	90 Minutes
3	On	HESP, CESP, and Exhaust Stack	PM ₁₀ , PM _{2.5} , Condensable PM	3	90 Minutes
3	Off	HESP, CESP, and Exhaust Stack	PM ₁₀ , PM _{2.5} , Condensable PM	3	90 Minutes
3	On	Exhaust Gas Stack	HCl, HF	3	60 Minutes
3	Off	Exhaust Gas Stack	HCl, HF	3	60 Minutes

A process flow diagram is presented below.



The required measurement parameters and EPA test methods to accomplish the objective were:

40 CFR Part 60, Appendix A, EPA Methods

- Method 1 and 2 Velocity
- Method 3A Oxygen and Carbon Dioxide
- Method 4 Moisture
- Method 202 Condensible PM
- Method 26 HCl, HF

EPA Conditional Test Methods (CTM)

- CTM 040 PM₁₀ and PM_{2.5}

2.0 SUMMARY AND DISCUSSION OF RESULTS

The results summarized in this report are those results associated with only valid test runs.

2.1 TEST OBJECTIVES

The objectives of the test program were as follows:

- Complete emissions tests for total particulate matter less than or equal to 10 microns (PM_{10}), particulate matter less than or equal to 2.5 microns ($PM_{2.5}$), and condensable particulate matter.
- Determine the emission rate of particulate matter in terms of the emission standard, pounds per million British Thermal Units (lb/MMBTU).

2.2 TEST CHANGES AND PROBLEMS FOR UNIT 2

2.2.1 Exhaust Stack

The test program was initiated on November 14, 2006. The first run completed on November 14, 2006 was voided due to failure of the final leak check. Run 2, started on November 15, 2006, was voided early in the run due a leak issue and was replaced with a new sample train, Run 3, in an attempt to capture stack exhaust gas results during the inlet (cold ESP, Hot ESP) Run 2 sample time period. Stack Run 3 was voided due to failing the final leak check. This attempt resulted in all future runs having the exhaust stack run numbered one run ahead of the inlet runs. Testing commenced again on December 4, 2006. The first test run conducted on that day (Run 4 for the stack sampling location) was voided due to a high sample volume on the Hot ESP Inlet sampling train. Stack Run 5 on December 5 was not used due to plant TRONA feed rate problems.

2.2.2 Cold ESP Inlet

The test program was initiated on November 14, 2006. Test Runs 1 and 2 were completed on November 14 and 15, 2006, respectively. Test Run 1 was voided due to excessive post-test leak check greater than the ± 0.02 cfm criteria. Test Run 2 was voided because no particulate matter

was noted in the cyclones. Testing commenced again on December 4, 2006. The first test run conducted on that day (Run 3 for the CESP location) was voided due to a high sample volume on the Hot ESP Inlet sampling train. CESP Run 4 on December 5 was not used due to plant TRONA feed rate problems.

2.2.3 Hot ESP Inlet

The test program was initiated on November 14, 2006. Test Runs 1, 2, and 3 were completed on November 14, 15, and December 4, respectively. Test Runs 1, 2, and 3 were voided due to high isokinetic ratios. During Test Run 4 the operator noted an increase in the sample vacuum at Port B point 4 through all points at Port C. It was determined that the filter heater had malfunctioned and that moisture was condensing on the filter causing an increase in the pressure drop. This run was voided. HESP Run 4 on December 5 was not used due to plant TRONA feed rate problems.

2.3 TEST CHANGES AND PROBLEMS FOR UNIT 3

Testing at the exhaust stack, CESP and HESP locations was initiated on December 14, 2006. Six valid test runs were completed between December 14 and December 17, 2006. Three tests were completed with TRONA injection and three test runs were completed without TRONA injection. No problems were encountered during the entire sampling program.

2.4 PRESENTATION OF RESULTS FOR UNIT 2

Three valid test runs were completed on Unit 2 at the three sampling locations (CESP, HESP, and Exhaust Stack) between December 5 and December 6, 2006. All three test runs were conducted with TRONA injection. Table 2-1 presents the start and stop time for each test run and the associated run number for each sampling location.

The test results for PM_{2.5} and PM₁₀ are summarized in Tables 2-2 and 2-3 respectively. The tables provide the emission rates (lbs/MMBtu) for Filterable particulate matter (PM) which consists of the cyclone catches, filter catches, and rinse catches, and Filterable PM and

condensable particulate matter (CPM) which consists of Filterable PM and the condensable organic and inorganic particulate matter captured in and extracted from the impinger solution. The tables also summarize the particulate removal efficiencies of the HESP (HESP emission rate verses CESP emission rate), the CESP (CESP emission rate verses the stack emission rate), and the overall total removal efficiency (HESP emission rate verses the stack emission rate).

The average PM_{2.5} emission rate for the exhaust stack was 0.0009 lbs/MMBtu for Filterable PM and 0.0133 lbs/MMBtu for Filterable PM + CPM. The average PM_{2.5} Filterable PM emission rates for the cold ESP inlet (CESP) and hot ESP inlet (HESP) were 0.0088 lbs/MMBtu and 0.561 lbs/MMBtu respectively. The average PM_{2.5} Filterable PM + CPM emission rates for the CESP and HESP were 0.0304 lbs/MMBtu and 0.589 lbs/MMBtu respectively. The overall PM_{2.5} removal efficiency (RE) for Filterable PM was 99.83%. The individual run emission rates and REs are provided in Table 2-2.

The average PM₁₀ emission rate for the exhaust stack was 0.0038 lbs/MMBtu for Filterable PM and 0.0162 lbs/MMBtu for Filterable PM + CPM. The average PM₁₀ Filterable PM emission rates for the CESP and HESP were 0.0105 lbs/MMBtu and 3.86 lbs/MMBtu respectively. The average PM₁₀ Filterable PM + CPM emission rates for the CESP and HESP were 0.0321 lbs/MMBtu and 3.89 lbs/MMBtu respectively. The overall PM₁₀ RE for Filterable PM was 99.90%. The individual run emission rates and REs are provided in Table 2-3.

2.5 PRESENTATION OF RESULTS FOR UNIT 3

Six valid test runs were completed on Unit 3 at the three sampling locations (CESP, HESP, and Exhaust Stack) between December 14 and December 17, 2006. Three tests were completed with TRONA injection, and three tests were completed without TRONA injection. Table 2-5 presents the start and stop time for each test run and the associated run number for each sampling location.

The test results for PM_{2.5} and PM₁₀ with TRONA on are summarized in Tables 2-5 and 2-6

respectively. The test results for PM_{2.5} and PM₁₀ with TRONA off are summarized in Tables 2-7 and 2-8 respectively. The tables provide the emission rates (lbs/MMBtu) for Filterable particulate matter (PM) which consists of the cyclone catches, filter catches, and rinse catches, and Filterable PM and condensable particulate matter (CPM) which consists of Filterable PM and the condensable organic and inorganic particulate matter captured in and extracted from the impinger solution. The tables also summarize the particulate removal efficiencies of the HESP (HESP emission rate verses CESP emission rate), the CESP (CESP emission rate verses the stack emission rate), and the overall total removal efficiency (HESP emission rate verses the stack emission rate).

The average PM_{2.5} emission rate for the exhaust stack was 0.0006 lbs/MMBtu for Filterable PM and 0.0120 lbs/MMBtu for Filterable PM + CPM for TRONA on and 0.0009 lbs/MMBtu for Filterable PM and 0.0145 lbs/MMBtu for Filterable PM + CPM for TRONA off. The average PM_{2.5} Filterable PM emission rates for the CESP and HESP were 0.0113 lbs/MMBtu and 0.4102 lbs/MMBtu respectively for TRONA on and 0.0040 lbs/MMBtu and 0.2882 lbs/MMBtu respectively for TRONA off. The average PM_{2.5} Filterable PM + CPM emission rates for the CESP and HESP were 0.0343 lbs/MMBtu and 0.4662 lbs/MMBtu respectively for TRONA on and 0.0179 lbs/MMBtu and 0.3317 lbs/MMBtu respectively for TRONA off. The overall PM_{2.5} removal efficiency (RE) for Filterable PM was 99.84% for TRONA on and 99.67% for TRONA off. The individual run emission rates and RE are provided in Tables 2-5 and 2-7.

The average PM₁₀ emission rate for the exhaust stack was 0.0027 lbs/MMBtu for Filterable PM and 0.0140 lbs/MMBtu for Filterable PM + CPM for TRONA on and 0.0027 lbs/MMBtu for Filterable PM and 0.0162 lbs/MMBtu for Filterable PM + CPM for TRONA off. The average PM_{2.5} Filterable PM emission rates for the CESP and HESP were 0.0279 lbs/MMBtu and 2.7366 lbs/MMBtu respectively for TRONA on and 0.0166 lbs/MMBtu and 1.7987 lbs/MMBtu respectively for TRONA off. The average PM₁₀ Filterable PM + CPM emission rates for the CESP and HESP were 0.0509 lbs/MMBtu and 2.7926 lbs/MMBtu respectively for TRONA on and 0.0305 lbs/MMBtu and 1.8422 lbs/MMBtu respectively for TRONA off. The overall PM₁₀ removal efficiency (RE) for Filterable PM was 99.90% for TRONA on and 99.67% for

TRONA off. The individual run emission rates and RE are provided in Tables 2-6 and 2-8.

2.6 PRESENTATION OF HCl and HF TEST RESULTS

Six valid Method 26 test runs were completed on Unit 3 at the Exhaust Stack sampling location. Three tests were completed on December 14, 2006 with TRONA injection, and three tests were completed on December 15, 2006 without TRONA injection. Tables 2-9 and 2-10 present the HCl and HF emission rates (mg/dscm) for TRONA on and TRONA off conditions respectively.

The average HCl emission rate for the exhaust stack with TRONA on was 1.418 mg/dscm and 108.2 mg/dscm with TRONA off. The average HF emission rate for the exhaust stack with TRONA on was 0.986 mg/dscm and 4.415 mg/dscm with TRONA off. The HCl and HF emission rates for the individual test runs are summarized in Tables 2-9 and 2-10.

Table 2-1
Potomac River Generating Station
Test Run Times - Unit 2 (TRONA ON)
(Valid Test Runs Only)

DATE	LOCATION	START	STOP	TRAIN	RUN #
5-Dec-06 Tuesday	STACK	18:31	20:20	CTM-040/202	CTM-R6
	CESP	18:50	19:52		CTM-R5
	HESP	19:00	19:39		CTM-R5
6-Dec-06 Wednesday	STACK	12:37	14:17	CTM-040/202	CTM-R7
	CESP	12:52	13:50		CTM-R6
	HESP	13:07	13:46		CTM-R6
	STACK	18:35	20:20	CTM-040/202	CTM-R8
	CESP	18:50	19:51		CTM-R7
	HESP	19:10	19:49		CTM-R7

Table 2-2
Potomac River Generating Station
Unit 2 -TRONA On
PM2.5 Emission Rate in lb/MMBtu

Location		12/5/2006 Run 6/5	12/6/2006 Run 7/6	12/6/2006 Run 8/7	Average
Stack	Filterable PM	0.0006	0.0013	0.0009	0.0009
	Filterable + CPM	0.0151	0.0145	0.0104	0.0133
Cold ESP Inlet	Filterable PM	0.0221	0.0026	0.0017	0.0088
	Filterable + CPM	0.0460	0.0279	0.0174	0.0304
Hot ESP Inlet	Filterable PM	0.562	0.680	0.441	0.561
	Filterable + CPM	0.594	0.711	0.463	0.589
Removal Efficiency (RE)					
Total	Filterable PM	99.90%	99.81%	99.80%	99.83%
HESP	Filterable PM	96.07%	99.61%	99.61%	98.43%
CESP	Filterable PM	97.35%	49.55%	48.94%	65.28%

Table 2-3
Potomac River Generating Station
Unit 2 -TRONA On
PM10 Emission Rate in lb/MMBtu

Location		12/5/2006 Run 6/5	12/6/2006 Run 7/6	12/6/2006 Run 8/7	Average
Stack	Filterable PM	0.0024	0.0064	0.0025	0.0038
	Filterable + CPM	0.0170	0.0196	0.0120	0.0162
Cold ESP Inlet	Filterable PM	0.0232	0.0041	0.0041	0.0105
	Filterable + CPM	0.0471	0.0294	0.0197	0.0321
Hot ESP Inlet	Filterable PM	4.13	3.74	3.70	3.86
	Filterable + CPM	4.16	3.78	3.72	3.89
Removal Efficiency (RE)					
Total	Filterable PM	99.94%	99.83%	99.93%	99.90%
HESP	Filterable PM	99.44%	99.89%	99.89%	99.74%
CESP	Filterable PM	89.56%	-55.51%	38.95%	24.33%

PM10 represents all particulate matter less than 10 microns, and is inclusive of particulate matter less than 2.5 microns

Table 2-4
Potomac River Generating Station
Test Run Times - Unit 3
(Valid Test Runs Only)

DATE	LOCATION	START	STOP	TRAIN	RUN #	TRONA
14-Dec-06 Thursday	STACK	16:04	17:42	CTM-040/202	CTM-R1	ON
	CESP	16:04	17:30	CTM-040/202		
	HESP	16:34	17:10	CTM-040/202		
15-Dec-06 Friday	STACK	13:00	14:37	CTM-040/202	CTM-R2	OFF
	CESP	13:00	14:26	CTM-040/202		
	HESP	13:30	14:06	CTM-040/202		
	STACK	17:56	19:30	CTM-040/202	CTM-R3	OFF
	CESP	17:56	19:24	CTM-040/202		
	HESP	18:26	19:02	CTM-040/202		
16-Dec-06 Saturday	STACK	11:45	13:27	CTM-040/202	CTM-R4	ON
	CESP	11:45	13:16	CTM-040/202		
	HESP	12:15	12:53	CTM-040/202		
	STACK	17:33	19:12	CTM-040/202	CTM-R5	ON
	CESP	17:33	19:03	CTM-040/202		
	HESP	18:03	18:39	CTM-040/202		
17-Dec-06 Sunday	STACK	11:55	13:35	CTM-040/202	CTM-R6	OFF
	CESP	11:55	13:26	CTM-040/202		
	HESP	12:25	13:01	CTM-040/202		

Table 2-5
Potomac River Generating Station
Unit 3 -TRONA On
PM2.5 Emission Rate in lb/MMBtu

Location		12/14/2006 Run 1	12/16/2006 Run 4	12/16/2006 Run 5	Average
Stack	Filterable Only	0.0006	0.0009	0.0004	0.0006
	Filterable + CPM	0.0110	0.0129	0.0121	0.0120
Cold ESP Inlet	Filterable Only	0.0152	0.0104	0.0083	0.0113
	Filterable + CPM	0.0438	0.0298	0.0292	0.0343
Hot ESP Inlet	Filterable Only	0.448	0.377	0.405	0.4102
	Filterable + CPM	0.463	0.458	0.477	0.4662
Removal Efficiency (RE)					
Total	Filterable PM	99.86%	99.76%	99.90%	99.84%
HESP	Filterable PM	96.61%	97.25%	97.95%	97.27%
CESP	Filterable PM	96.01%	91.13%	94.93%	94.02%

Table 2-6
Potomac River Generating Station
Unit 3 -TRONA On
PM10 Emission Rate in lb/MMBtu

Location		12/14/2006 Run 1	12/16/2006 Run 4	12/16/2006 Run 5	Average
Stack	Filterable Only	0.0029	0.0026	0.0025	0.0027
	Filterable + CPM	0.0133	0.0145	0.0142	0.0140
Cold ESP Inlet	Filterable Only	0.0421	0.0268	0.0148	0.0279
	Filterable + CPM	0.0707	0.0463	0.0358	0.0509
Hot ESP Inlet	Filterable Only	2.925	2.506	2.779	2.7366
	Filterable + CPM	2.939	2.587	2.851	2.7926
Removal Efficiency (RE)					
Total	Filterable PM	99.90%	99.90%	99.91%	99.90%
HESP	Filterable PM	98.56%	98.93%	99.47%	98.99%
CESP	Filterable PM	93.21%	90.34%	82.94%	88.83%

PM10 represents all particulate matter less than 10 microns, and is inclusive of particulate matter less than 2.5 microns

Table 2-7
Potomac River Generating Station
Unit 3 -TRONA Off
PM2.5 Emission Rate in lb/MMBtu

Location		12/15/2006 Run 2	12/15/2006 Run 3	12/17/2006 Run 6	Average
Stack	Filterable Only	0.0008	0.0008	0.0011	0.0009
	Filterable + CPM	0.0147	0.0138	0.0149	0.0145
Cold ESP Inlet	Filterable Only	0.0022	0.0050	0.0048	0.0040
	Filterable + CPM	0.0145	0.0083	0.0309	0.0179
Hot ESP Inlet	Filterable Only	0.3219	0.2947	0.2481	0.2882
	Filterable + CPM	0.3439	0.3826	0.2687	0.3317
Removal Efficiency (RE)					
Total	Filterable PM	99.76%	99.72%	99.54%	99.67%
HESP	Filterable PM	99.32%	98.32%	98.07%	98.57%
CESP	Filterable PM	64.52%	83.29%	75.97%	74.60%

Table 2-8
Potomac River Generating Station
Unit 3 -TRONA Off
PM10 Emission Rate in lb/MMBtu

Location		12/15/2006 Run 2	12/15/2006 Run 3	12/17/2006 Run 6	Average
Stack	Filterable Only	0.0024	0.0021	0.0035	0.0027
	Filterable + CPM	0.0163	0.0151	0.0173	0.0162
Cold ESP Inlet	Filterable Only	0.0048	0.0078	0.0374	0.0166
	Filterable + CPM	0.0171	0.0111	0.0635	0.0305
Hot ESP Inlet	Filterable Only	2.0140	1.7432	1.6389	1.7987
	Filterable + CPM	2.0360	1.8311	1.6595	1.8422
Removal Efficiency (RE)					
Total	Filterable PM	99.88%	99.88%	99.78%	99.85%
HESP	Filterable PM	99.76%	99.55%	97.72%	99.01%
CESP	Filterable PM	49.83%	73.34%	90.56%	71.24%

PM10 represents all particulate matter less than 10 microns, and is inclusive of particulate matter less than 2.5 microns

Table 2-9
Potomac River Generating Station
Unit 3 (TRONA ON)
HCl/HF Emission Rate

Run No.	1	2	3	Average
Date:	14-Dec-06	14-Dec-06	14-Dec-06	
Start Time	16:04	17:21	19:21	
Stop Time	17:04	18:21	20:21	
TRONA	ON	ON	ON	
Barometric Pressure, (inches of mercury)	29.80	29.80	29.80	
Net Sampling Time, (minutes)	60.0	60.0	60.0	
Volume Metered, (cubic feet)	4.072	4.236	4.236	
Average Dry Gas Meter Temperature, (°F)	75	74	68	
Average Dry Gas Meter Temperature, (°K)	297	296	293	
Dry Gas Meter Calibration Factor (Y) Meterbox # 7001	1.005	1.005	1.005	
Volume of Gas Collected, (dscf)	4.022	4.193	4.240	
O ₂ Concentration, (percent dry)	4.2	4.2	5.4	
EMISSIONS				
HCl Quantity, mg	0.043	0.222	0.241	0.169
HCl Concentration, mg/dscf	0.011	0.053	0.057	0.040
HCl emission rate, lb/MMBtu	2.88E-04	1.43E-03	1.65E-03	1.12E-03
HF Quantity, mg	0.065	0.141	0.144	0.117
HF Concentration, mg/dscf	0.016	0.034	0.034	0.028
HF emission rate, lb/MMBtu	4.36E-04	9.07E-04	9.85E-04	7.76E-04

Table 2-10
Potomac River Generating Station
Unit 3 (TRONA OFF)
HCl/HF Emission Rate

Run No.	4	5	6	Average
Date:	15-Dec-06	15-Dec-06	15-Dec-06	
Start Time	13:00	15:19	16:34	
Stop Time	14:00	16:19	17:34	
TRONA	OFF	OFF	OFF	
Barometric Pressure, (inches of mercury)	29.85	29.85	29.85	
Net Sampling Time, (minutes)	60.0	60.0	60.0	
Volume Metered, (cubic feet)	4.241	4.240	4.240	
Average Dry Gas Meter Temperature, (°F)	74	81	80	
Average Dry Gas Meter Temperature, (°K)	296	300	300	
Dry Gas Meter Calibration Factor (Y) Meterbox # 7001	1.005	1.005	1.005	
Volume of Gas Collected, (dscf)	4.204	4.149	4.157	
O ₂ Concentration, (percent dry)	5.6	5.6	5.6	
EMISSIONS				
HCl Quantity, mg	9.68	18.4	10.2	12.760
HCl Concentration, mg/dscf	2.302	4.435	2.454	3.064
HCl emission rate, lb/MMBtu	6.76E-02	1.30E-01	7.21E-02	9.00E-02
HF Quantity, mg	0.454	0.676	0.433	0.521
HF Concentration, mg/dscf	0.108	0.163	0.104	0.125
HF emission rate, lb/MMBtu	3.17E-03	4.79E-03	3.06E-03	3.67E-03

3.0 PLANT OPERATING DATA AND SAMPLING LOCATION

3.1 PLANT OPERATING DATA

Mirant was responsible for the documentation of facility operating conditions during the test program. Plant operating data collected by Mirant plant personnel has been included in the Final Report. The following data was recorded electronically for each unit during each test run.

- ◆ Facility CEMS data for SO₂, NO_x, CO₂ and CO
- ◆ ESP primary and secondary voltages
- ◆ ESP primary and secondary amps
- ◆ ESP Spark Rate
- ◆ ESP fields in operation
- ◆ Trona injection rate
- ◆ Coal firing rate
- ◆ Megawatts
- ◆ Opacity

In addition as fired coal samples were collected by facility personnel during each test run.

3.2 SAMPLING LOCATIONS

The procedures specified by EPA Method 1, "*Sample and Velocity Traverses for Stationary Sources*", were followed to determine the number and location of traverse points to be used for the stratification testing and velocity traverses. The numbers of straight run stack diameters (equivalent diameters) upstream and downstream from the sample ports were used to determine the minimum number of traverse points required.

In the case of the hot and cold side ESP inlet sampling locations the minimum criteria for up and downstream diameters was not achievable. The Alternative Measurement Site Selection

Procedure (40CFR Appendix A, Method 1 Section 2.5) was utilized to determine that sampling could be performed at these locations.

4.0 FIELD SAMPLING PROGRAM

4.1 OVERVIEW

This section describes the procedures that TRC followed during the field-sampling program. Throughout the program TRC followed EPA Reference Methods 40 CFR Part 60 Appendix A and EPA Conditional Test Method 040. The remainder of this section is divided into several subsections: Field Program Description, Pre-sampling Activities, and Onsite Sampling Activities.

4.2 FIELD PROGRAM DESCRIPTION

The field sampling was conducted by TRC over two field events, event 1, November 14 and 15, 2006, and event 2 December 2 through 7, 2006. The test methods utilized in accordance with 40 CFR Part 60 were as follows:

- | | |
|------------------|--|
| • EPA Method 1 | Sample Velocity Traverse for Stationary Sources |
| • EPA Method 2 | Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot tube) |
| • EPA Method 3A | Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure) |
| • EPA Method 4 | Determination of Moisture Content in Stack Gases |
| • EPA Method 202 | Determination of Condensable Particulate Emissions from Stationary Sources |
| • EPA Method 26 | Determination of Hydrogen Halide and Halogen Emissions from Stationary Sources Non-Isokinetic Method |

The test methods utilized in accordance with EPA Conditional Test Methods were as follows:

- | | |
|---------------|---|
| • EPA CTM 040 | Determination of PM ₁₀ and PM _{2.5} Emissions |
|---------------|---|

4.3 PRE-SAMPLING ACTIVITIES

Pre-sampling activities included equipment calibration, pre-cleaning of the sample train glassware, and other miscellaneous tasks. Each of these activities is described or referenced in the following subsections. Other pre-sampling activities included team meetings, equipment packing, and finalization of all details leading up to the coordinated initiation of the sampling program.

4.3.1 Equipment Calibration

Inspection and calibration of the equipment is a crucial step in ensuring the successful completion of the field effort. All equipment was inspected for proper operation and durability prior to calibration. Calibration of the following equipment was conducted in accordance with the procedures outlined in EPA documents entitled "*Quality Assurance Handbook for Air Pollution Measurement Systems; Volume III - Stationary Source Specific Methods*" and 40 CFR Part 60 Appendix A. Copies of the equipment calibration forms are found in Appendix E. All calibrations were performed prior to the test program and have been included in the final report.

4.4 ONSITE SAMPLING ACTIVITIES

Onsite sampling activities included conducting velocity traverses, sampling for particulate matter, moisture, oxygen and carbon dioxide.

4.4.1 EPA Methods 1 and 2 for Velocity Measurement

Velocity traverses were conducted at the sampling location with an S-type pitot assembly in accordance with 40 CFR Part 60, Appendix A, Method 1 "*Sample and Velocity Traverses for*

Stationary Sources” and Method 2 “*Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)*”. An S-type Pitot tube with an attached inclined manometer was used to measure the exhaust velocities of the outlet stack. An attached Type-K thermocouple with remote digital display was used to determine the flue gas temperature. During the test program, velocity measurements were conducted during each test run. The required number of velocity measurement points for the sampling location was determined following EPA Method 1.

4.4.2 EPA Method 3A for Flue Gas Molecular Weight

Oxygen and carbon dioxide concentrations were determined at the outlet stack for each test run according to EPA Reference Method 3A, “*Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)*”. TRC collected the exhaust gas in Tedlar bags during each test run. Analyses of the collected Tedlar bags were performed at the conclusion of the test day.

The exhaust gas was collected at the outlet of each sampling train’s dry gas meter using the Nutech Orsat outlet. The sample was drawn through the sample train where moisture was removed from the gas stream and was collected in a Tedlar bag following the dry gas meter. The collection of the sample started only after the sampling train had been running for at least two minutes to ensure that the oxygen present in the impinger train had been adequately purged. After collection of the Tedlar bag sample, the Tedlar bag was connected to the Transportable Continuous Emissions Monitoring System (TCEMS). The sample was then drawn through Teflon[®] tubing by a leak-free Teflon[®] double diaphragm pump to a stainless-steel sample manifold with an atmospheric by-pass rotameter. The O₂ and CO₂ analyzers drew samples from this manifold.

All TCEMS data was recorded as averages by a STRATA digital data logger designed to receive and log instrument signals. The results were expressed in percent concentrations for O₂ and CO₂.

4.4.3 EPA Method 4 for Moisture Determination

Moisture was determined for each test run according to EPA Reference Method 4, "*Determination of Moisture Content in Stack Gases*". The principle of this method is to remove the moisture from the sample stream and determine moisture either volumetrically or gravimetrically. Method 4 was used in conjunction with the CTM 040/202 sampling train during the test program.

4.4.4 EPA CTM 040/202 for PM₁₀, PM_{2.5} and Condensable

Particulate matter equal to or less than 10 microns in diameter (PM₁₀) and particulate matter equal to or less than 2.5 microns in diameter (PM_{2.5}) was determined according to EPA Methods CTM-040, "*Determination of PM₁₀ and PM_{2.5} Emissions (Constant Sampling Rate Procedures)*" dated December 3, 2002. Additionally, EPA Method 202, "*Determination of Condensable Particulate Emissions from Stationary Sources*" (40 CFR Part 61, Appendix M) was used to determine condensable particulate. The sampling train consisted of a pre-cutter nozzle, a series of in-stack sizing devices (cyclones), an in-stack filter, a heated glass probe with a S-type Pitot tube attached, four chilled impingers, and a metering console. A schematic of the sampling train is presented in Figure 4-1.

The particulate with an aerodynamic size of ≤ 10 microns (PM₁₀) and particulate with an aerodynamic size of ≤ 2.5 microns (PM_{2.5}) were collected using Anderson 280 Series cyclones followed by a 63 mm Whatman EPM2000 glass fiber filter. The Anderson cyclones and 63 mm filter were pre-heated prior to sampling. The first two impingers each contained 100 mL of HPLC Grade deionized, distilled (DI) water, and the third impinger was empty and the fourth contained silica gel. Initial weights for all impingers were determined gravimetrically prior to each test run.

A preliminary velocity traverse (twelve points maximum) was performed to determine the velocity head (Δp) and gas temperature at each traverse point. Based on the flue gas parameters,

the appropriate flow rate (acfm) into the nozzle was selected for the PM₁₀ and PM_{2.5} cuts. The desired nozzle size was calculated; the nozzle closest to the desired size was selected from the nozzles available, and the desired velocity into the selected nozzle was calculated. The desired velocity into the actual nozzle and the measured flue gas velocity at each traverse point were compared to verify that the isokinetic ratio was maintained between 80% and 120%. The sampling rate remained constant for the duration of the run while the sampling time at each traverse point was adjusted proportionally to the velocity at that point to provide a velocity weighted sample. The Δp measured for each point during the preliminary traverse was used to calculate the individual sampling durations during the test runs.

Leak checks of the probe and sample train (without the sample head (combined cyclone/filter assembly)) were performed before and after each sampling run. All leak checks and leakage rates were documented on the relevant field test data sheets. The acceptance criterion for the CTM 040/202 train was a leak rate of ≤ 0.02 cfm at the highest vacuum obtained during the test run.

Following the completion of each test run, the CTM 040/202 train was transported to a recovery area onsite. Recovery involved the quantitative transfer of particles in the following size ranges: (1) greater than 10 microns, (2) less than or equal to 10 microns but greater than 2.5 microns, and (3) less than or equal to 2.5 microns. The recovery sequence proceeded as follows:

- Removed the sampling train to the recovery area.
- Noted the condition of the train (i.e., filter condition, impinger contents color, silica gel color, etc.).
- Disassembled the filter housing and transferred the filter to its original petri dish. Sealed the container with Teflon[®] tape and labeled it with the appropriate sample information. (Container #1).
- The cyclone I cup, internal surfaces of the nozzle, and the internal surfaces of the cyclone I, including the outside surface to the downcomer line were brush-rinsed with acetone into an amber glass container with a Teflon[®]-lined cap. The rinse procedure was performed three times after which the container was sealed, liquid level marked, and container labeled. (Container #2).

- The solids from the cyclone cup IV, the acetone rinses of the cyclone I turnaround cup, the inside of the downcomer line and the internal surfaces of the cyclone IV, were placed into an amber glass container with a Teflon[®]-lined cap. The container was sealed, liquid level marked, and labeled. (Container #3).
- The exit tube of the cyclone IV cup, and the front half of the filter holder were rinsed with acetone and placed into an amber glass container with a Teflon[®]-lined cap. The container was sealed, liquid level marked, and labeled. (Container #4).
- The silica gel was returned to its original container and weighed to obtain a final weight. (Container #5).
- 50 ml of the acetone were taken directly from the wash bottle and placed into a glass container. The container was sealed, liquid level marked, and labeled as the Acetone Rinse Blank. (Container #6).
- The impinger contents were purged with nitrogen to remove dissolved sulfur dioxide and afterwards, the contents of the first three impingers were measured for volume and the contents were collected in an amber glass container with a Teflon[®]-lined cap. The container was sealed, liquid level marked, and labeled (Container #7).
- The back-half of the filter holder, probe, impingers, and connecting glassware were rinsed three times with methylene chloride (MeCl₂) into a separate amber glass container with a Teflon[®]-lined cap (Container #8).
- All containers were checked to ensure proper sealing, proper labeling, and that all liquid levels were marked.
- All samples were logged onto a chain-of-custody form.

The filter, front, and back-half rinses were used to determine PM concentrations. The impinger catches (impingers 1 thru 4) were also used to determine moisture and condensable material.

The samples were analyzed in accordance with the procedures presented in Section 5.1.1 of this test plan.

4.4.5 EPA Method 26 for HCl/HF

Hydrogen Chloride and Hydrogen Fluoride (HCl/HF) emissions were determined according to

EPA Method 26, "*Determination of Hydrogen Halide and Halogen Emissions from Stationary Sources Non-Isokinetic Method*" (40 CFR Part 60 Appendix A). Sampling consisted of three one-hour test runs for each TRONA on and TRONA off conditions.

The sampling train consisted of a heated probe and glass-liner. The sample gas passed through the heated probe assembly to a heated filter holder assembly containing a quartz fiber filter and a Teflon® frit support. Downstream of the heated filter, the sample gas passed through a series of five ice-cooled midjet impingers kept below 68°F to enable condensation of entrained moisture. The first and second impingers each contained 15 mL of 0.1N H₂SO₄. The third and fourth impingers contained 15 mL of 0.1N NaOH. The fifth impinger contained silica gel. The impingers were followed by a dry gas meter, pump, and a calibrated orifice meter.

Sampling will be non-isokinetic and at a sampling rate of approximately 2 liters per minute. The readings of flue gas parameters were recorded every five minutes during the sampling period. A total sample gas volume of approximately 120 liters was collected.

Leak checks of the entire Method 26 sampling train were performed before and after each sampling run.

Following the completion of each test run, the Method 26 train was transported to the recovery area onsite. The recovery sequence proceeded as follows:

- Remove the sampling train to the recovery area.
- Note the condition of the train (i.e., filter condition, impinger contents color, silica gel color, etc.).
- Placed the contents of the first two impingers into a sample container (Container #1). Rinsed the impingers with deionized water and added the rinse to Container #1. The container was then be sealed, labeled and the liquid level marked.
- Placed the contents of the third and fourth impingers into a sample container (Container #2). Rinsed the impingers with deionized water and add the rinse to Container #2. Added sodium thiosulfate to Container #2 in the amount prescribed by Method 26. The container was then be sealed, labeled and the liquid level

marked.

The Method 26 train produced the following samples:

- Container No. 1 - Contents of Impingers 1 and 2
- Container No. 2 - Contents of Impingers 3 and 4

Additionally, reagent blanks for the deionized water, the 0.1N H₂SO₄ and the 0.1N NaOH were collected, logged onto the chain of custody form and submitted for analysis.

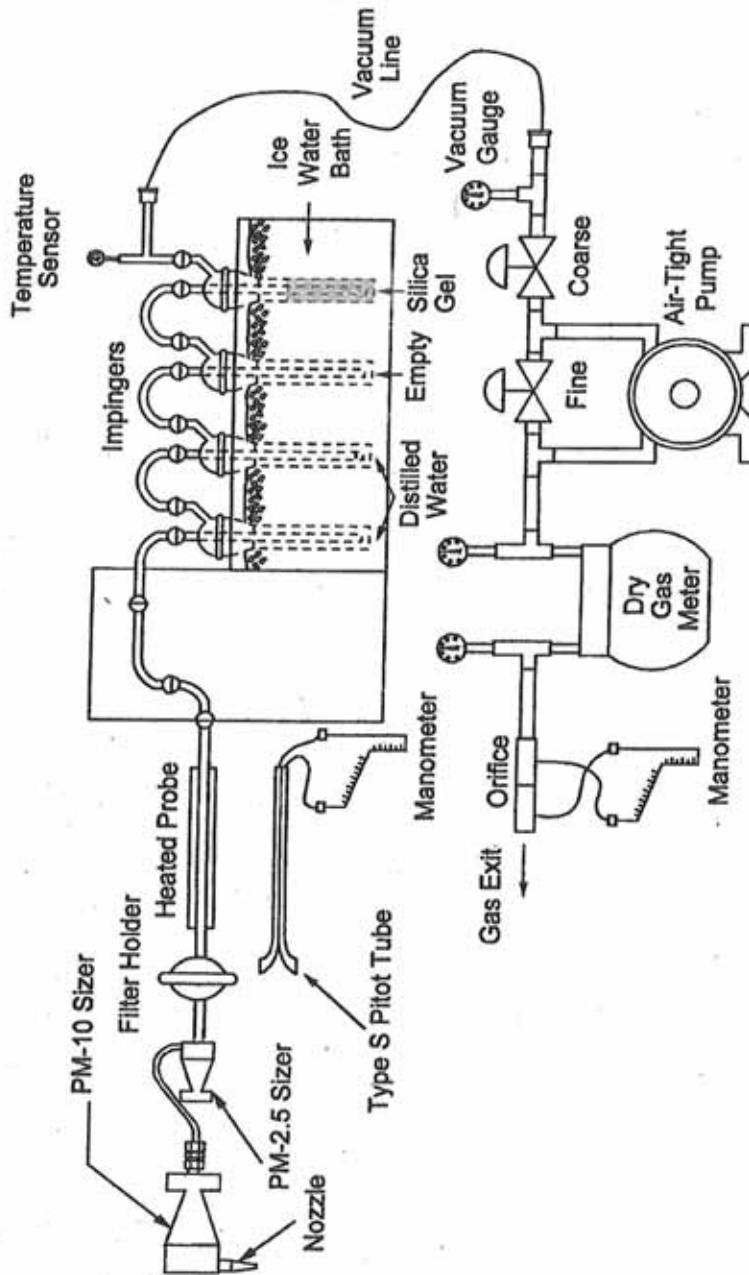


Figure 4-1. EPA CTM 040/202 Sampling Train

5.0 ANALYTICAL PROCEDURES AND CALCULATIONS

This section delineates the analytical procedures and calculations, which were used to analyze and report the sample results for this test program.

5.1 ANALYTICAL PROCEDURES

5.1.1 Particulate Matter

PM₁₀, PM_{2.5}, and Condensable sampling analysis were accomplished by following the procedures in EPA Methods CTM-040 and 202. The glass fiber filters were placed in glass petri dishes and desiccated to a constant weight. An identification label was placed on the petri dish. The containers used for the dry down of the acetone rinse were cleaned, dried in an oven at 250°F, and desiccated to a constant weight prior to use for analytical purposes.

The contents from Container Nos. 2, 3, 4 and 6 were air dried in a tared container and then desiccated and weighed to a constant weight. The filter was desiccated and weighed to constant weight. The sum of the net weights for the probe wash and filter catch were used to calculate the concentration of filterable particulate matter.

The contents of Container Nos. 7 and 8 were combined and extracted with MeCl to separate the organic and inorganic fractions. The organic fraction was desiccated and weighed to a constant weight. The inorganic fraction was analyzed in accordance with the method procedures (EPA Method 5F) for determination and correction of sulfate, chloride, and NH_4^+ contribution. The sum of the organic and inorganic fractions was reported as the total condensable particulate. The sum of the filterable and condensable particulate fractions has been reported as the total PM.

5.2 CALCULATIONS

5.2.1 Flowrates

Calculations for the determination of dry gas sampled at standard conditions (dscf), gas velocity at stack conditions (afpm), and gas volumetric flow rate at standard conditions (dscfm) were as follows.

5.2.1.1 *Volume of Dry Gas Sampled at Standard Conditions*

Volume of dry gas sampled at standard conditions, dscf^a

$$\text{dscf}^a = \frac{528 \times (Y) \times (VM) \times (PB + PM)}{29.92 \times (TM + 460)}$$

where:

^a	=	Dry standard cubic feet at 68°F (528°R) and 29.92 inches of Hg
Y	=	Dry gas meter calibration factor
VM	=	Sample gas Volume, ft ³
PB	=	Barometric Pressure
PM	=	Average Orifice Pressure Drop, inches of Hg
TM	=	Average Dry Gas Temperature at meter, °F

5.2.1.2 *Velocity of the Exhaust Gas*

Stack gas velocity at stack conditions were determined in terms of feet per minute(fpm)

$$\text{fpm} = 5130^c \times C_p \times \text{SDE}_{\text{avg}} \times \left[\frac{1}{\text{PS} \times \text{MW}} \right]^{1/2}$$

where:

^c	=	$5130 = \frac{85.5 \text{ ft}}{\text{sec}} \left[\frac{(\text{lb/lb - mole}) \times (\text{in. Hg})}{(^{\circ}\text{R}) \times (\text{in. H}_2\text{O})} \right] \times 60 \text{ sec/min}$
C _p	=	Pitot tube coefficient
SDE _{avg}	=	$\left(\sqrt{\Delta P} \right)_{\text{avg}} \times \sqrt{\text{Stack Temp}_{\text{avg}} + 460}$
PS	=	Stack Pressure, absolute inches of Hg = Barometric Pressure ± Avg Stack Static Pressure

MW = Molecular Weight of Wet Stack Gas

5.2.1.3 Volumetric Flow Rate of the Exhaust Gas

Stack gas volumetric flow rate at standard conditions, dscfm^c

$$\text{dscfm}^c = \frac{\text{acfm} \times 528 \times \text{MD} \times \text{PS}}{(29.92) \times (\text{TS}_{\text{avg}} + 460)}$$

where:

^c = Dry standard cubic feet per minute at 68°F (528°R) and 29.92 in.Hg
acfm = Actual cubic feet per minute (fpm x cross sectional area of stack)
MD = Mole Fraction of Dry Gas (dimensionless)
PS = Stack Pressure, absolute, inches of Hg
TS_{avg} = Average Stack Temperature

5.2.2 Particulate Matter - Grains per Dry Standard Cubic Foot

Emission rates in terms of grains per dry standard cubic feet (gr/dscf) were calculated using the PM_{total} weight in terms of milligrams (mg) divided by the volume of gas collected (dscf).

$$\text{gr/dscf} = 0.0154 \times \left[\text{mg}(\text{total}) \div \left\{ \frac{528 \times (Y) \times (VM) \times (PB + PM)}{29.92 \times (TM + 460)} \right\} \right]$$

where:

mg_(total) = PM_{total}, filterable and condensable particulate
dscf = Dry standard cubic feet at 68°F (528°R) and 29.92 inches Hg
0.0154 = 0.0154 grains per milligram
Y = Dry gas meter calibration factor
VM = Volume metered, ft³
PB = Barometric Pressure, inches Hg
PM = Average Orifice Pressure Drop, inches Hg
TM = Average Dry Gas Temperature at Meter, °F

5.2.3 Particulate Matter – Pounds per Million BTU

Emission rates were calculated in units of pollutant mass per quantity of heat input (lbs/MMBtu). The emission rates were calculated using the particulate diluent concentrations and the default F-factor for coal (e.g., 9780) as specified in EPA Method 19. Measured PM emission concentrations were converted to a mass emission factor in terms of lbs/MMBtu using EPA Method 19, Equation 19-1:

$$PM_{total} (lbs/MMBtu) = \frac{PM_{total}(gr/dscf)}{7000 (gr/lb)} \times F_d (dscf/MMBtu) \times \frac{20.9}{20.9 - \% O_2 \text{ measured}}$$

where:

F_d = Ratio of the volume of dry effluent gas to the gross calorific value of the As-fired fuel. (Default F-factor for coal, in terms of dscf/MMBtu was used).

5.2.4 Particulate Matter – Pounds per Hour

Emission rates in terms of pounds per hour (lbs/hr) were calculated using the PM emission concentration in terms of grains per dry standard cubic foot (gr/dscf), the outlet stack flowrate Q_s (dscfm) and the emission factor of 7000 grains in a pound (gr/lb).

$$PM_{total} (lbs/hr) = \frac{PM_{total}(gr/dscf) \times Q_s(dscfm) \times 60 \text{ min/hr}}{7000 \text{ gr/lb}}$$

5.2.5 Mass of Hydrogen Halides HCl and HF

The mass of the HCl and HF in the samples were calculated using the following equation:

$$M = K \times V_s (Sx^- - Bx^-)$$

Where:

M = Mass, ug

K = K_{HCl} is 1.028

K_{HF} is 1.053

V = Volume of filtered and diluted sample, ml

Sx^- = Analysis of sample of halide ion (Cl^- or F^-), ug/ml

Bx^- = Mass concentration of solution blank for halide ion (Cl^- or F^-), ug/l

5.2.6 Concentrations of Hydrogen Halides HCl and HF

The concentrations of HCl and HF in the samples were calculated using the following equation:

$$C = \frac{M \times 10^{-3} \text{ mg/ug}}{V_m(\text{std})}$$

Where:

C = Concentration of HCl or HF, mg/dscm

V_m(std)= Dry Gas Volume Measured, Standard

5.2.7 HCl and HF – Pounds per Million BTU

Emission rates were calculated in units of pollutant mass per quantity of heat input (lbs/MMBtu). The emission rates were calculated using the HCl and HF diluent concentrations and the default F-factor for coal (e.g., 9780). Measured HCl and HF emission concentrations were converted to a mass emission factor in terms of lbs/MMBtu using the following equation:

$$\text{HCl/HF (lbs/MMBtu)} = \frac{0.0154}{7000 \text{ (gr/lb)}} \times F_d \text{ (dscf/MMBtu)} \times \frac{20.9}{20.9 - \% \text{ O}_2 \text{ measured}}$$

where:

0.0154 = Conversion factor to convert mg/dscf to gr/dscf

F_d = Ratio of the volume of dry effluent gas to the gross calorific value of the As-fired fuel. (Default F-factor for coal in terms of dscf/MMBtu was used).

6.0 QUALITY ASSURANCE

6.1 OVERVIEW

TRC Environmental Corporation management is fully committed to an effective Quality Assurance/Quality Control Program whose objective is the delivery of a quality product. For much of TRC's work, that product is data resulting from field measurements, sampling and analysis activities, engineering assessments, and the analysis of gathered data for planning purposes. The Quality Assurance Program works to provide complete, precise, accurate, representative data in a timely manner for each project, considering both the project's needs and budget constraints.

This section highlights the specific QA/QC procedures followed for this Test Program.

6.2 FIELD QUALITY CONTROL SUMMARY

6.2.1 Calibration Procedures

Calibration of the field sampling equipment was performed prior to the field sampling effort. Copies of the calibration sheets were submitted to the field team leader to take onsite and placed into the project file. Calibrations were performed as described in the EPA publications "*Quality Assurance Handbook for Air Pollution Measurement Systems; Volume III - Stationary Source Specific Methods*" and EPA 40 CFR Part 60 Appendix A. Equipment calibrated included the sample metering system, nozzles, barometers, thermocouples, and Pitot tubes. All calibrations were available for review during the test program. Copies of the equipment calibration forms are be found in Appendix E.

6.2.2 Equipment Leak Checks

Prior to sampling, each sampling train was leak checked according to the procedures outlined in

EPA Reference Method 5. Final leak checks were performed to ensure that no leaks developed in the train during the course of each test run. All leakage rates, if any found, were recorded on the appropriate field data sheet.

6.2.3 Calibration Gases

All calibration gases used to conduct instrument calibrations were prepared in accordance with the EPA Protocol 1.

6.2.4 Cyclonic Flow Check

The absence of cyclonic flow within the outlet stack was established prior to sampling, in accordance with Section 2.4 of EPA Method 1.

6.2.5 Method Blanks

One Method blank for the CTM 040/202 sampling train was taken during the field-sampling program to ensure sample quality.

6.3 SAMPLE CHAIN OF CUSTODY

The chain-of-custody of the samples were initiated and maintained as follows:

- Each sample was collected, labeled, sealed, and the liquid level marked on appropriate samples.
- The sample was recorded on the sample chain-of-custody form.
- Custody of the samples was retained by TRC until delivery to the analytical laboratory for analysis.

6.4 DATA REDUCTION, VALIDATION, AND REPORTING

Specific QC measures were used to ensure the generation of reliable data from sampling and analysis activities. Proper collection and organization of accurate information followed by clear and concise reporting of the data is a primary goal in all projects.

6.4.1 Field Data Reduction

The Field Team Leader and at least one other field crewmember reviewed the data collected in the field. Any recording errors or discrepancies were noted on the field data sheet. Copies of all field data sheets have been included with the final report.

6.4.2 Laboratory Analysis Data Reduction

Analytical results were reduced to concentration units specified by the analytical procedures, using the equations provided in the analytical procedures.

6.4.3 Data Validation

TRC supervisory and QC personnel used validation methods and criteria appropriate to the type of data and the purpose of the measurement. Records of all data were maintained, including any judged to be an "outlying" or spurious value. The persons who validated the data have sufficient knowledge of the technical work to identify questionable values.

The Field Team Leader and/or the Field QC Coordinator based on their review of the adherence to an approved sampling protocol and written sample collection procedure validated field-sampling data.

Analytical data was validated using criteria outlined below. TRC utilized results from the field method blank to further validate analytical results. Furthermore, TRC reviewed all laboratory raw analytical data to verify calculated results presented.

The following criteria were used to evaluate the field sampling data:

- Use of approved test procedures;
- Proper operation of the process being tested;
- Use of properly operating and calibrated equipment;
- Leak checks conducted before and after tests;
- Use of reagents conforming to QC specified criteria;
- Proper chain-of-custody maintained.

The criteria listed below were used to evaluate the analytical data:

- Use of approved analytical procedures;
- Use of properly operating and calibrated instrumentation;
- Results of Reagent and Method Blanks.

6.4.4 Data Reporting

All data has been reported in standard units depending on the measurement and the ultimate use of the data. The bulk of the data was computer processed and has been reported using Excel as follows:

- Exhaust Gas Stream
 - Gas Properties:
 - a. Moisture, dscf and percent by volume
 - b. Flow rate, dscfm and acfm
 - c. Pressure, mm of Hg
 - d. Temperature, °F
 - Particulate:
 - a. gr/dscf and lbs/MMBtu
 - HCl:
 - a. mg/dscf and mg/dscm
 - Gas Diluents
 - a. O₂, percent
 - b. CO₂, percent

APPENDIX A
FIELD SAMPLING DATA SHEETS

APPENDIX A.1

UNIT 2

FIELD SAMPLING DATA SHEETS

APPENDIX A.2

UNIT 2

CEMS DATA

APPENDIX A.3

UNIT 3

FIELD SAMPLING DATA SHEETS

APPENDIX A.3.1
UNIT 3 – TRONA ON
FIELD SAMPLING DATA SHEETS

APPENDIX A.3.2
UNIT 3 – TRONA OFF
FIELD SAMPLING DATA SHEETS

APPENDIX A.4

UNIT 3

CEMS DATA

APPENDIX B
FIELD REDUCED DATA

APPENDIX B.1

UNIT 2

FIELD REDUCED DATA

APPENDIX B.2

UNIT 3

FIELD REDUCED DATA

APPENDIX B.2.1
UNIT 3 – TRONA ON
FIELD REDUCED DATA

APPENDIX B.2.2
UNIT 3 – TRONA OFF
FIELD REDUCED DATA

APPENDIX C
FACILITY PROCESS DATA

APPENDIX C.1

UNIT 2

FACILITY PROCESS DATA

APPENDIX C.2

UNIT 3

FACILITY PROCESS DATA

APPENDIX C.3

UNIT 3

FACILITY PROCESS DATA

FOR HCI/HF TESTS

APPENDIX D
LABORATORY ANALYTICAL DATA

APPENDIX E
EQUIPMENT CALIBRATION DATA SHEETS

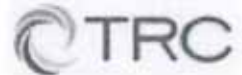
Final Report

Particulate Emissions (PM₁₀, PM_{2.5} and Condensable) and Hydrochloric Acid Emissions Testing at Potomac River Generating Station Alexandria, Virginia

Prepared for:

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December 2006

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1.0 INTRODUCTION

1.1 OVERVIEW

TRC of Lowell, Massachusetts was retained by Mirant Potomac River, LLC (Mirant) to provide sampling and analytical support in completing a Particulate Emission Test Program at the Potomac River Generating Facility. The Test Program at the Potomac facility involved the completion of emissions tests for total particulate matter less than or equal to 10 microns (PM_{10}), particulate matter less than or equal to 2.5 microns ($PM_{2.5}$), and condensable particulate matter. All tests were completed under normal operating conditions while the units tested were maintained at 90% of full load or greater. Additionally, testing was conducted on Unit 3 at the stack outlet for hydrochloric acid (HCl) and hydrogen fluoride (HF) emissions.

The results obtained during this test program support the contention that the use of Trona injection in combination with electrostatic precipitators results in a reduced emission rate of particulate matter. The Trona supplier, Solvay Chemicals, has presented technical papers at various industry forums that describe how electrostatic precipitator efficiency is improved with the use of sodium sorbents (see www.solvaychemicals.us). The principal mechanism for the enhanced performance is derived from the additional sodium present in the fly-ash. With the sodium present, ash resistivity decreases allowing for more efficient particulate matter collection by the electrostatic precipitator.

1.2 SCOPE OF WORK

The test program for particulate emissions was conducted on Units 2 and 3 at the facility. Testing was performed at three locations on each unit. The sampling locations were as follows: the inlet to the hot side electrostatic precipitator (HESP), the inlet to the cold side ESP (CESP), and the exhaust stack of each unit. Testing on each unit occurred with every effort to maintain a 75% SO_2 reduction rate during the test, but in no case did the reduction rate fall below 70% SO_2 reduction. All test runs for Unit 2 were completed with TRONA injection. A series of test runs

were completed for Unit 3 with and without TRONA injection. Table 1-1 summarizes the tests completed on each unit during the test program.

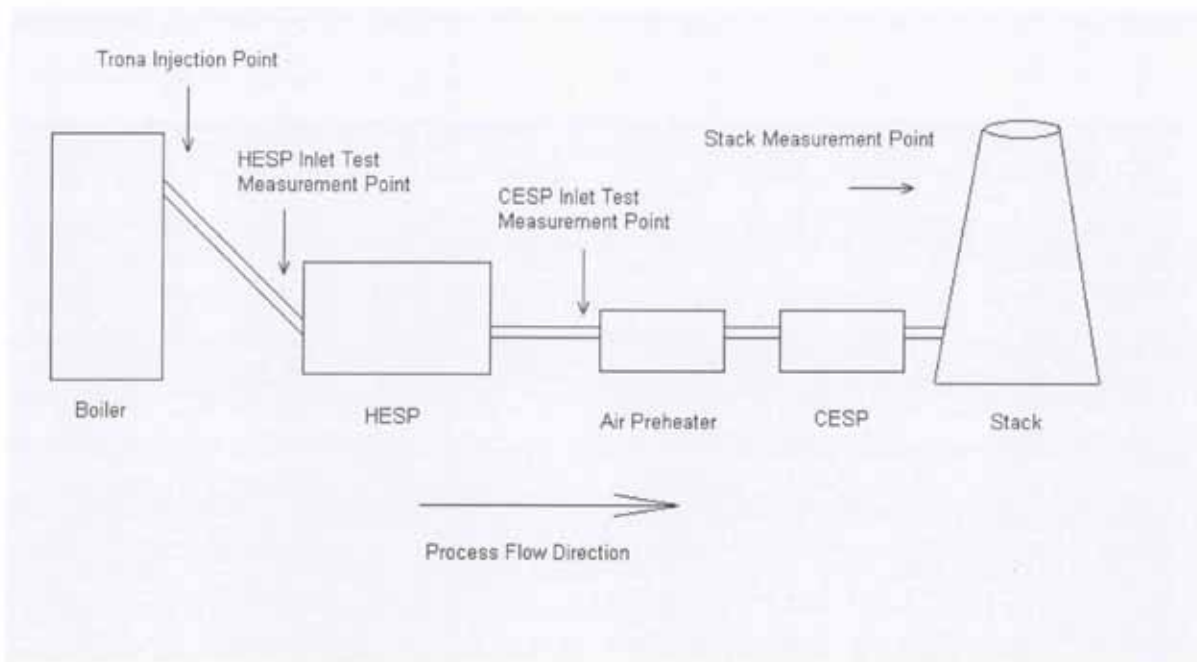
The testing determined the emission rate of particulate matter in terms of the emission standard (lb/MMBTU).

Testing for HCl and HF emissions was conducted on Unit 3 at the stack outlet location.

Table 1-1. Summary of Test Conditions

Unit	Trona	Test Locations	Test Parameters	No. of Test Runs	Run Duration
2	On	HESP, CESP , and Exhaust Stack	PM ₁₀ ,PM _{2.5} ,Condensable PM	5	90 Minutes
3	On	HESP, CESP , and Exhaust Stack	PM ₁₀ ,PM _{2.5} ,Condensable PM	3	90 Minutes
3	Off	HESP, CESP , and Exhaust Stack	PM ₁₀ ,PM _{2.5} ,Condensable PM	3	90 Minutes
3	On	Exhaust Gas Stack	HCl, HF	3	60 Minutes
3	Off	Exhaust Gas Stack	HCl, HF	3	60 Minutes

A process flow diagram is presented below.



The required measurement parameters and EPA test methods to accomplish the objective were:

40 CFR Part 60, Appendix A, EPA Methods

- Method 1 and 2 Velocity
- Method 3A Oxygen and Carbon Dioxide
- Method 4 Moisture
- Method 202 Condensible PM
- Method 26 HCl, HF

EPA Conditional Test Methods (CTM)

- CTM 040 PM₁₀ and PM_{2.5}

2.0 SUMMARY AND DISCUSSION OF RESULTS

The results summarized in this report are those results associated with only valid test runs.

2.1 TEST OBJECTIVES

The objectives of the test program were as follows:

- Complete emissions tests for total particulate matter less than or equal to 10 microns (PM₁₀), particulate matter less than or equal to 2.5 microns (PM_{2.5}), and condensable particulate matter.
- Determine the emission rate of particulate matter in terms of the emission standard, pounds per million British Thermal Units (lb/MMBTU).

2.2 TEST CHANGES AND PROBLEMS FOR UNIT 2

2.2.1 Exhaust Stack

The test program was initiated on November 14, 2006. The first run completed on November 14, 2006 was voided due to failure of the final leak check. Run 2, started on November 15, 2006, was voided early in the run due a leak issue and was replaced with a new sample train, Run 3, in an attempt to capture stack exhaust gas results during the inlet (cold ESP, Hot ESP) Run 2 sample time period. Stack Run 3 was voided due to failing the final leak check. This attempt resulted in all future runs having the exhaust stack run numbered one run ahead of the inlet runs. Testing commenced again on December 4, 2006. The first test run conducted on that day (Run 4 for the stack sampling location) was voided due to a high sample volume on the Hot ESP Inlet sampling train. Stack Run 5 on December 5 was not used due to plant TRONA feed rate problems.

2.2.2 Cold ESP Inlet

The test program was initiated on November 14, 2006. Test Runs 1 and 2 were completed on November 14 and 15, 2006, respectively. Test Run 1 was voided due to excessive post-test leak check greater than the ± 0.02 cfm criteria. Test Run 2 was voided because no particulate matter

was noted in the cyclones. Testing commenced again on December 4, 2006. The first test run conducted on that day (Run 3 for the CESP location) was voided due to a high sample volume on the Hot ESP Inlet sampling train. CESP Run 4 on December 5 was not used due to plant TRONA feed rate problems.

2.2.3 Hot ESP Inlet

The test program was initiated on November 14, 2006. Test Runs 1, 2, and 3 were completed on November 14, 15, and December 4, respectively. Test Runs 1, 2, and 3 were voided due to high isokinetic ratios. During Test Run 4 the operator noted an increase in the sample vacuum at Port B point 4 through all points at Port C. It was determined that the filter heater had malfunctioned and that moisture was condensing on the filter causing an increase in the pressure drop. This run was voided. HESP Run 4 on December 5 was not used due to plant TRONA feed rate problems.

2.3 TEST CHANGES AND PROBLEMS FOR UNIT 3

Testing at the exhaust stack, CESP and HESP locations was initiated on December 14, 2006. Six valid test runs were completed between December 14 and December 17, 2006. Three tests were completed with TRONA injection and three test runs were completed without TRONA injection. No problems were encountered during the entire sampling program.

2.4 PRESENTATION OF RESULTS FOR UNIT 2

Three valid test runs were completed on Unit 2 at the three sampling locations (CESP, HESP, and Exhaust Stack) between December 5 and December 6, 2006. All three test runs were conducted with TRONA injection. Table 2-1 presents the start and stop time for each test run and the associated run number for each sampling location.

The test results for PM_{2.5} and PM₁₀ are summarized in Tables 2-2 and 2-3 respectively. The tables provide the emission rates (lbs/MMBtu) for Filterable particulate matter (PM) which consists of the cyclone catches, filter catches, and rinse catches, and Filterable PM and

condensable particulate matter (CPM) which consists of Filterable PM and the condensable organic and inorganic particulate matter captured in and extracted from the impinger solution. The tables also summarize the particulate removal efficiencies of the HESP (HESP emission rate versus CESP emission rate), the CESP (CESP emission rate versus the stack emission rate), and the overall total removal efficiency (HESP emission rate versus the stack emission rate).

The average PM_{2.5} emission rate for the exhaust stack was 0.0009 lbs/MMBtu for Filterable PM and 0.0133 lbs/MMBtu for Filterable PM + CPM. The average PM_{2.5} Filterable PM emission rates for the cold ESP inlet (CESP) and hot ESP inlet (HESP) were 0.0088 lbs/MMBtu and 0.561 lbs/MMBtu respectively. The average PM_{2.5} Filterable PM + CPM emission rates for the CESP and HESP were 0.0304 lbs/MMBtu and 0.589 lbs/MMBtu respectively. The overall PM_{2.5} removal efficiency (RE) for Filterable PM was 99.83%. The individual run emission rates and REs are provided in Table 2-2.

The average PM₁₀ emission rate for the exhaust stack was 0.0038 lbs/MMBtu for Filterable PM and 0.0162 lbs/MMBtu for Filterable PM + CPM. The average PM₁₀ Filterable PM emission rates for the CESP and HESP were 0.0105 lbs/MMBtu and 3.86 lbs/MMBtu respectively. The average PM₁₀ Filterable PM + CPM emission rates for the CESP and HESP were 0.0321 lbs/MMBtu and 3.89 lbs/MMBtu respectively. The overall PM₁₀ RE for Filterable PM was 99.90%. The individual run emission rates and REs are provided in Table 2-3.

2.5 PRESENTATION OF RESULTS FOR UNIT 3

Six valid test runs were completed on Unit 3 at the three sampling locations (CESP, HESP, and Exhaust Stack) between December 14 and December 17, 2006. Three tests were completed with TRONA injection, and three tests were completed without TRONA injection. Table 2-5 presents the start and stop time for each test run and the associated run number for each sampling location.

The test results for PM_{2.5} and PM₁₀ with TRONA on are summarized in Tables 2-5 and 2-6

respectively. The test results for PM_{2.5} and PM₁₀ with TRONA off are summarized in Tables 2-7 and 2-8 respectively. The tables provide the emission rates (lbs/MMBtu) for Filterable particulate matter (PM) which consists of the cyclone catches, filter catches, and rinse catches, and Filterable PM and condensable particulate matter (CPM) which consists of Filterable PM and the condensable organic and inorganic particulate matter captured in and extracted from the impinger solution. The tables also summarize the particulate removal efficiencies of the HESP (HESP emission rate versus CESP emission rate), the CESP (CESP emission rate versus the stack emission rate), and the overall total removal efficiency (HESP emission rate versus the stack emission rate).

The average PM_{2.5} emission rate for the exhaust stack was 0.0006 lbs/MMBtu for Filterable PM and 0.0120 lbs/MMBtu for Filterable PM + CPM for TRONA on and 0.0009 lbs/MMBtu for Filterable PM and 0.0145 lbs/MMBtu for Filterable PM + CPM for TRONA off. The average PM_{2.5} Filterable PM emission rates for the CESP and HESP were 0.0113 lbs/MMBtu and 0.4102 lbs/MMBtu respectively for TRONA on and 0.0040 lbs/MMBtu and 0.2882 lbs/MMBtu respectively for TRONA off. The average PM_{2.5} Filterable PM + CPM emission rates for the CESP and HESP were 0.0343 lbs/MMBtu and 0.4662 lbs/MMBtu respectively for TRONA on and 0.0179 lbs/MMBtu and 0.3317 lbs/MMBtu respectively for TRONA off. The overall PM_{2.5} removal efficiency (RE) for Filterable PM was 99.84% for TRONA on and 99.67% for TRONA off. The individual run emission rates and RE are provided in Tables 2-5 and 2-7.

The average PM₁₀ emission rate for the exhaust stack was 0.0027 lbs/MMBtu for Filterable PM and 0.0140 lbs/MMBtu for Filterable PM + CPM for TRONA on and 0.0027 lbs/MMBtu for Filterable PM and 0.0162 lbs/MMBtu for Filterable PM + CPM for TRONA off. The average PM_{2.5} Filterable PM emission rates for the CESP and HESP were 0.0279 lbs/MMBtu and 2.7366 lbs/MMBtu respectively for TRONA on and 0.0166 lbs/MMBtu and 1.7987 lbs/MMBtu respectively for TRONA off. The average PM₁₀ Filterable PM + CPM emission rates for the CESP and HESP were 0.0509 lbs/MMBtu and 2.7926 lbs/MMBtu respectively for TRONA on and 0.0305 lbs/MMBtu and 1.8422 lbs/MMBtu respectively for TRONA off. The overall PM₁₀ removal efficiency (RE) for Filterable PM was 99.90% for TRONA on and 99.67% for

TRONA off. The individual run emission rates and RE are provided in Tables 2-6 and 2-8.

2.6 PRESENTATION OF HCl and HF TEST RESULTS

Six valid Method 26 test runs were completed on Unit 3 at the Exhaust Stack sampling location. Three tests were completed on December 14, 2006 with TRONA injection, and three tests were completed on December 15, 2006 without TRONA injection. Tables 2-9 and 2-10 present the HCl and HF emission rates (mg/dscm) for TRONA on and TRONA off conditions respectively.

The average HCl emission rate for the exhaust stack with TRONA on was 1.418 mg/dscm and 108.2 mg/dscm with TRONA off. The average HF emission rate for the exhaust stack with TRONA on was 0.986 mg/dscm and 4.415 mg/dscm with TRONA off. The HCl and HF emission rates for the individual test runs are summarized in Tables 2-9 and 2-10.

Table 2-1
Potomac River Generating Station
Test Run Times - Unit 2 (TRONA ON)
(Valid Test Runs Only)

DATE	LOCATION	START	STOP	TRAIN	RUN #
5-Dec-06 Tuesday	STACK	18:31	20:20	CTM-040/202	CTM-R6
	CESP	18:50	19:52		CTM-R5
	HESP	19:00	19:39		CTM-R5
6-Dec-06 Wednesday	STACK	12:37	14:17	CTM-040/202	CTM-R7
	CESP	12:52	13:50		CTM-R6
	HESP	13:07	13:46		CTM-R6
	STACK	18:35	20:20	CTM-040/202	CTM-R8
	CESP	18:50	19:51		CTM-R7
	HESP	19:10	19:49		CTM-R7

Table 2-2
Potomac River Generating Station
Unit 2 -TRONA On
PM2.5 Emission Rate in lb/MMBtu

Location		12/5/2006 Run 6/5	12/6/2006 Run 7/6	12/6/2006 Run 8/7	Average
Stack	Filterable PM	0.0006	0.0013	0.0009	0.0009
	Filterable + CPM	0.0151	0.0145	0.0104	0.0133
Cold ESP Inlet	Filterable PM	0.0221	0.0026	0.0017	0.0088
	Filterable + CPM	0.0460	0.0279	0.0174	0.0304
Hot ESP Inlet	Filterable PM	0.562	0.680	0.441	0.561
	Filterable + CPM	0.594	0.711	0.463	0.589
Removal Efficiency (RE)					
Total	Filterable PM	99.90%	99.81%	99.80%	99.83%
HESP	Filterable PM	96.07%	99.61%	99.61%	98.43%
CESP	Filterable PM	97.35%	49.55%	48.94%	65.28%

Table 2-3
Potomac River Generating Station
Unit 2 -TRONA On
PM10 Emission Rate in lb/MMBtu

Location		12/5/2006 Run 6/5	12/6/2006 Run 7/6	12/6/2006 Run 8/7	Average
Stack	Filterable PM	0.0024	0.0064	0.0025	0.0038
	Filterable + CPM	0.0170	0.0196	0.0120	0.0162
Cold ESP Inlet	Filterable PM	0.0232	0.0041	0.0041	0.0105
	Filterable + CPM	0.0471	0.0294	0.0197	0.0321
Hot ESP Inlet	Filterable PM	4.13	3.74	3.70	3.86
	Filterable + CPM	4.16	3.78	3.72	3.89
Removal Efficiency (RE)					
Total	Filterable PM	99.94%	99.83%	99.93%	99.90%
HESP	Filterable PM	99.44%	99.89%	99.89%	99.74%
CESP	Filterable PM	89.56%	-55.51%	38.95%	24.33%

PM10 represents all particulate matter less than 10 microns, and is inclusive of particulate matter less than 2.5 microns

Table 2-4
Potomac River Generating Station
Test Run Times - Unit 3
(Valid Test Runs Only)

DATE	LOCATION	START	STOP	TRAIN	RUN #	TRONA
14-Dec-06 Thursday	STACK	16:04	17:42	CTM-040/202	CTM-R1	ON
	CESP	16:04	17:30	CTM-040/202		
	HESP	16:34	17:10	CTM-040/202		
15-Dec-06 Friday	STACK	13:00	14:37	CTM-040/202	CTM-R2	OFF
	CESP	13:00	14:26	CTM-040/202		
	HESP	13:30	14:06	CTM-040/202		
	STACK	17:56	19:30	CTM-040/202	CTM-R3	OFF
	CESP	17:56	19:24	CTM-040/202		
	HESP	18:26	19:02	CTM-040/202		
16-Dec-06 Saturday	STACK	11:45	13:27	CTM-040/202	CTM-R4	ON
	CESP	11:45	13:16	CTM-040/202		
	HESP	12:15	12:53	CTM-040/202		
	STACK	17:33	19:12	CTM-040/202	CTM-R5	ON
	CESP	17:33	19:03	CTM-040/202		
	HESP	18:03	18:39	CTM-040/202		
17-Dec-06 Sunday	STACK	11:55	13:35	CTM-040/202	CTM-R6	OFF
	CESP	11:55	13:26	CTM-040/202		
	HESP	12:25	13:01	CTM-040/202		

Table 2-5
Potomac River Generating Station
Unit 3 -TRONA On
PM2.5 Emission Rate in lb/MMBtu

Location		12/14/2006 Run 1	12/16/2006 Run 4	12/16/2006 Run 5	Average
Stack	Filterable Only	0.0006	0.0009	0.0004	0.0006
	Filterable + CPM	0.0110	0.0129	0.0121	0.0120
Cold ESP Inlet	Filterable Only	0.0152	0.0104	0.0083	0.0113
	Filterable + CPM	0.0438	0.0298	0.0292	0.0343
Hot ESP Inlet	Filterable Only	0.448	0.377	0.405	0.4102
	Filterable + CPM	0.463	0.458	0.477	0.4662
Removal Efficiency (RE)					
Total	Filterable PM	99.86%	99.76%	99.90%	99.84%
HESP	Filterable PM	96.61%	97.25%	97.95%	97.27%
CESP	Filterable PM	96.01%	91.13%	94.93%	94.02%

Table 2-6
Potomac River Generating Station
Unit 3 -TRONA On
PM10 Emission Rate in lb/MMBtu

Location		12/14/2006 Run 1	12/16/2006 Run 4	12/16/2006 Run 5	Average
Stack	Filterable Only	0.0029	0.0026	0.0025	0.0027
	Filterable + CPM	0.0133	0.0145	0.0142	0.0140
Cold ESP Inlet	Filterable Only	0.0421	0.0268	0.0148	0.0279
	Filterable + CPM	0.0707	0.0463	0.0358	0.0509
Hot ESP Inlet	Filterable Only	2.925	2.506	2.779	2.7366
	Filterable + CPM	2.939	2.587	2.851	2.7926
Removal Efficiency (RE)					
Total	Filterable PM	99.90%	99.90%	99.91%	99.90%
HESP	Filterable PM	98.56%	98.93%	99.47%	98.99%
CESP	Filterable PM	93.21%	90.34%	82.94%	88.83%

PM10 represents all particulate matter less than 10 microns, and is inclusive of particulate matter less than 2.5 microns

Table 2-7
Potomac River Generating Station
Unit 3 -TRONA Off
PM2.5 Emission Rate in lb/MMBtu

Location		12/15/2006 Run 2	12/15/2006 Run 3	12/17/2006 Run 6	Average
Stack	Filterable Only	0.0008	0.0008	0.0011	0.0009
	Filterable + CPM	0.0147	0.0138	0.0149	0.0145
Cold ESP Inlet	Filterable Only	0.0022	0.0050	0.0048	0.0040
	Filterable + CPM	0.0145	0.0083	0.0309	0.0179
Hot ESP Inlet	Filterable Only	0.3219	0.2947	0.2481	0.2882
	Filterable + CPM	0.3439	0.3826	0.2687	0.3317
Removal Efficiency (RE)					
Total	Filterable PM	99.76%	99.72%	99.54%	99.67%
HESP	Filterable PM	99.32%	98.32%	98.07%	98.57%
CESP	Filterable PM	64.52%	83.29%	75.97%	74.60%

Table 2-8
Potomac River Generating Station
Unit 3 -TRONA Off
PM10 Emission Rate in lb/MMBtu

Location		12/15/2006 Run 2	12/15/2006 Run 3	12/17/2006 Run 6	Average
Stack	Filterable Only	0.0024	0.0021	0.0035	0.0027
	Filterable + CPM	0.0163	0.0151	0.0173	0.0162
Cold ESP Inlet	Filterable Only	0.0048	0.0078	0.0374	0.0166
	Filterable + CPM	0.0171	0.0111	0.0635	0.0305
Hot ESP Inlet	Filterable Only	2.0140	1.7432	1.6389	1.7987
	Filterable + CPM	2.0360	1.8311	1.6595	1.8422
Removal Efficiency (RE)					
Total	Filterable PM	99.88%	99.88%	99.78%	99.85%
HESP	Filterable PM	99.76%	99.55%	97.72%	99.01%
CESP	Filterable PM	49.83%	73.34%	90.56%	71.24%

PM10 represents all particulate matter less than 10 microns, and is inclusive of particulate matter less than 2.5 microns

Table 2-9
Potomac River Generating Station
Unit 3 (TRONA ON)
HCl/HF Emission Rate

Run No.	1	2	3	
Date:	14-Dec-06	14-Dec-06	14-Dec-06	Average
Start Time	16:04	17:21	19:21	
Stop Time	17:04	18:21	20:21	
TRONA	ON	ON	ON	
Barometric Pressure, (inches of mercury)	29.80	29.80	29.80	
Net Sampling Time, (minutes)	60.0	60.0	60.0	
Volume Metered, (cubic feet)	4.072	4.236	4.236	
Average Dry Gas Meter Temperature, (°F)	75	74	68	
Average Dry Gas Meter Temperature, (°K)	297	296	293	
Dry Gas Meter Calibration Factor (Y) Meterbox # 7001	1.005	1.005	1.005	
Volume of Gas Collected, (dscf)	4.022	4.193	4.240	
O ₂ Concentration, (percent dry)	4.2	4.2	5.4	
EMISSIONS				
HCl Quantity, mg	0.043	0.222	0.241	0.169
HCl Concentration, mg/dscf	0.011	0.053	0.057	0.040
HCl emission rate, lb/MMBtu	2.88E-04	1.43E-03	1.65E-03	1.12E-03
HF Quantity, mg	0.065	0.141	0.144	0.117
HF Concentration, mg/dscf	0.016	0.034	0.034	0.028
HF emission rate, lb/MMBtu	4.36E-04	9.07E-04	9.85E-04	7.76E-04

Table 2-10
Potomac River Generating Station
Unit 3 (TRONA OFF)
HCl/HF Emission Rate

Run No.	4	5	6	
Date:	15-Dec-06	15-Dec-06	15-Dec-06	Average
Start Time	13:00	15:19	16:34	
Stop Time	14:00	16:19	17:34	
TRONA	OFF	OFF	OFF	
Barometric Pressure, (inches of mercury)	29.85	29.85	29.85	
Net Sampling Time, (minutes)	60.0	60.0	60.0	
Volume Metered, (cubic feet)	4.241	4.240	4.240	
Average Dry Gas Meter Temperature, (°F)	74	81	80	
Average Dry Gas Meter Temperature, (°K)	296	300	300	
Dry Gas Meter Calibration Factor (Y) Meterbox # 7001	1.005	1.005	1.005	
Volume of Gas Collected, (dscf)	4.204	4.149	4.157	
O ₂ Concentration, (percent dry)	5.6	5.6	5.6	
EMISSIONS				
HCl Quantity, mg	9.68	18.4	10.2	12.760
HCl Concentration, mg/dscf	2.302	4.435	2.454	3.064
HCl emission rate, lb/MMBtu	6.76E-02	1.30E-01	7.21E-02	9.00E-02
HF Quantity, mg	0.454	0.676	0.433	0.521
HF Concentration, mg/dscf	0.108	0.163	0.104	0.125
HF emission rate, lb/MMBtu	3.17E-03	4.79E-03	3.06E-03	3.67E-03

3.0 PLANT OPERATING DATA AND SAMPLING LOCATION

3.1 PLANT OPERATING DATA

Mirant was responsible for the documentation of facility operating conditions during the test program. Plant operating data collected by Mirant plant personnel has been included in the Final Report. The following data was recorded electronically for each unit during each test run.

- ◆ Facility CEMS data for SO₂, NO_x, CO₂ and CO
- ◆ ESP primary and secondary voltages
- ◆ ESP primary and secondary amps
- ◆ ESP Spark Rate
- ◆ ESP fields in operation
- ◆ Trona injection rate
- ◆ Coal firing rate
- ◆ Megawatts
- ◆ Opacity

In addition as fired coal samples were collected by facility personnel during each test run.

3.2 SAMPLING LOCATIONS

The procedures specified by EPA Method 1, "*Sample and Velocity Traverses for Stationary Sources*", were followed to determine the number and location of traverse points to be used for the stratification testing and velocity traverses. The numbers of straight run stack diameters (equivalent diameters) upstream and downstream from the sample ports were used to determine the minimum number of traverse points required.

In the case of the hot and cold side ESP inlet sampling locations the minimum criteria for up and downstream diameters was not achievable. The Alternative Measurement Site Selection

Procedure (40CFR Appendix A, Method 1 Section 2.5) was utilized to determine that sampling could be performed at these locations.

4.0 FIELD SAMPLING PROGRAM

4.1 OVERVIEW

This section describes the procedures that TRC followed during the field-sampling program. Throughout the program TRC followed EPA Reference Methods 40 CFR Part 60 Appendix A and EPA Conditional Test Method 040. The remainder of this section is divided into several subsections: Field Program Description, Pre-sampling Activities, and Onsite Sampling Activities.

4.2 FIELD PROGRAM DESCRIPTION

The field sampling was conducted by TRC over two field events, event 1, November 14 and 15, 2006, and event 2 December 2 through 7, 2006. The test methods utilized in accordance with 40 CFR Part 60 were as follows:

- | | |
|------------------|--|
| • EPA Method 1 | Sample Velocity Traverse for Stationary Sources |
| • EPA Method 2 | Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot tube) |
| • EPA Method 3A | Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure) |
| • EPA Method 4 | Determination of Moisture Content in Stack Gases |
| • EPA Method 202 | Determination of Condensable Particulate Emissions from Stationary Sources |
| • EPA Method 26 | Determination of Hydrogen Halide and Halogen Emissions from Stationary Sources Non-Isokinetic Method |

The test methods utilized in accordance with EPA Conditional Test Methods were as follows:

- | | |
|---------------|---|
| • EPA CTM 040 | Determination of PM ₁₀ and PM _{2.5} Emissions |
|---------------|---|

4.3 PRE-SAMPLING ACTIVITIES

Pre-sampling activities included equipment calibration, pre-cleaning of the sample train glassware, and other miscellaneous tasks. Each of these activities is described or referenced in the following subsections. Other pre-sampling activities included team meetings, equipment packing, and finalization of all details leading up to the coordinated initiation of the sampling program.

4.3.1 Equipment Calibration

Inspection and calibration of the equipment is a crucial step in ensuring the successful completion of the field effort. All equipment was inspected for proper operation and durability prior to calibration. Calibration of the following equipment was conducted in accordance with the procedures outlined in EPA documents entitled "*Quality Assurance Handbook for Air Pollution Measurement Systems; Volume III - Stationary Source Specific Methods*" and 40 CFR Part 60 Appendix A. Copies of the equipment calibration forms are found in Appendix E. All calibrations were performed prior to the test program and have been included in the final report.

4.4 ONSITE SAMPLING ACTIVITIES

Onsite sampling activities included conducting velocity traverses, sampling for particulate matter, moisture, oxygen and carbon dioxide.

4.4.1 EPA Methods 1 and 2 for Velocity Measurement

Velocity traverses were conducted at the sampling location with an S-type pitot assembly in accordance with 40 CFR Part 60, Appendix A, Method 1 "*Sample and Velocity Traverses for*

Stationary Sources” and Method 2 “*Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)*”. An S-type Pitot tube with an attached inclined manometer was used to measure the exhaust velocities of the outlet stack. An attached Type-K thermocouple with remote digital display was used to determine the flue gas temperature. During the test program, velocity measurements were conducted during each test run. The required number of velocity measurement points for the sampling location was determined following EPA Method 1.

4.4.2 EPA Method 3A for Flue Gas Molecular Weight

Oxygen and carbon dioxide concentrations were determined at the outlet stack for each test run according to EPA Reference Method 3A, “*Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)*”. TRC collected the exhaust gas in Tedlar bags during each test run. Analyses of the collected Tedlar bags were performed at the conclusion of the test day.

The exhaust gas was collected at the outlet of each sampling train’s dry gas meter using the Nutech Orsat outlet. The sample was drawn through the sample train where moisture was removed from the gas stream and was collected in a Tedlar bag following the dry gas meter. The collection of the sample started only after the sampling train had been running for at least two minutes to ensure that the oxygen present in the impinger train had been adequately purged. After collection of the Tedlar bag sample, the Tedlar bag was connected to the Transportable Continuous Emissions Monitoring System (TCEMS). The sample was then drawn through Teflon® tubing by a leak-free Teflon® double diaphragm pump to a stainless-steel sample manifold with an atmospheric by-pass rotameter. The O₂ and CO₂ analyzers drew samples from this manifold.

All TCEMS data was recorded as averages by a STRATA digital data logger designed to receive and log instrument signals. The results were expressed in percent concentrations for O₂ and CO₂.

4.4.3 EPA Method 4 for Moisture Determination

Moisture was determined for each test run according to EPA Reference Method 4, "*Determination of Moisture Content in Stack Gases*". The principle of this method is to remove the moisture from the sample stream and determine moisture either volumetrically or gravimetrically. Method 4 was used in conjunction with the CTM 040/202 sampling train during the test program.

4.4.4 EPA CTM 040/202 for PM₁₀, PM_{2.5} and Condensable

Particulate matter equal to or less than 10 microns in diameter (PM₁₀) and particulate matter equal to or less than 2.5 microns in diameter (PM_{2.5}) was determined according to EPA Methods CTM-040, "*Determination of PM₁₀ and PM_{2.5} Emissions (Constant Sampling Rate Procedures)*" dated December 3, 2002. Additionally, EPA Method 202, "*Determination of Condensable Particulate Emissions from Stationary Sources*" (40 CFR Part 61, Appendix M) was used to determine condensable particulate. The sampling train consisted of a pre-cutter nozzle, a series of in-stack sizing devices (cyclones), an in-stack filter, a heated glass probe with a S-type Pitot tube attached, four chilled impingers, and a metering console. A schematic of the sampling train is presented in Figure 4-1.

The particulate with an aerodynamic size of ≤ 10 microns (PM₁₀) and particulate with an aerodynamic size of ≤ 2.5 microns (PM_{2.5}) were collected using Anderson 280 Series cyclones followed by a 63 mm Whatman EPM2000 glass fiber filter. The Anderson cyclones and 63 mm filter were pre-heated prior to sampling. The first two impingers each contained 100 mL of HPLC Grade deionized, distilled (DI) water, and the third impinger was empty and the fourth contained silica gel. Initial weights for all impingers were determined gravimetrically prior to each test run.

A preliminary velocity traverse (twelve points maximum) was performed to determine the velocity head (Δp) and gas temperature at each traverse point. Based on the flue gas parameters,

the appropriate flow rate (acfm) into the nozzle was selected for the PM₁₀ and PM_{2.5} cuts. The desired nozzle size was calculated; the nozzle closest to the desired size was selected from the nozzles available, and the desired velocity into the selected nozzle was calculated. The desired velocity into the actual nozzle and the measured flue gas velocity at each traverse point were compared to verify that the isokinetic ratio was maintained between 80% and 120%. The sampling rate remained constant for the duration of the run while the sampling time at each traverse point was adjusted proportionally to the velocity at that point to provide a velocity weighted sample. The Δp measured for each point during the preliminary traverse was used to calculate the individual sampling durations during the test runs.

Leak checks of the probe and sample train (without the sample head (combined cyclone/filter assembly)) were performed before and after each sampling run. All leak checks and leakage rates were documented on the relevant field test data sheets. The acceptance criterion for the CTM 040/202 train was a leak rate of ≤ 0.02 cfm at the highest vacuum obtained during the test run.

Following the completion of each test run, the CTM 040/202 train was transported to a recovery area onsite. Recovery involved the quantitative transfer of particles in the following size ranges: (1) greater than 10 microns, (2) less than or equal to 10 microns but greater than 2.5 microns, and (3) less than or equal to 2.5 microns. The recovery sequence proceeded as follows:

- Removed the sampling train to the recovery area.
- Noted the condition of the train (i.e., filter condition, impinger contents color, silica gel color, etc.).
- Disassembled the filter housing and transferred the filter to its original petri dish. Sealed the container with Teflon[®] tape and labeled it with the appropriate sample information. (Container #1).
- The cyclone I cup, internal surfaces of the nozzle, and the internal surfaces of the cyclone I, including the outside surface to the downcomer line were brush-rinsed with acetone into an amber glass container with a Teflon[®]-lined cap. The rinse procedure was performed three times after which the container was sealed, liquid level marked, and container labeled. (Container #2).

- The solids from the cyclone cup IV, the acetone rinses of the cyclone I turnaround cup, the inside of the downcomer line and the internal surfaces of the cyclone IV, were placed into an amber glass container with a Teflon[®]-lined cap. The container was sealed, liquid level marked, and labeled. (Container #3).
- The exit tube of the cyclone IV cup, and the front half of the filter holder were rinsed with acetone and placed into an amber glass container with a Teflon[®]-lined cap. The container was sealed, liquid level marked, and labeled. (Container #4).
- The silica gel was returned to its original container and weighed to obtain a final weight. (Container #5).
- 50 ml of the acetone were taken directly from the wash bottle and placed into a glass container. The container was sealed, liquid level marked, and labeled as the Acetone Rinse Blank. (Container #6).
- The impinger contents were purged with nitrogen to remove dissolved sulfur dioxide and afterwards, the contents of the first three impingers were measured for volume and the contents were collected in an amber glass container with a Teflon[®]-lined cap. The container was sealed, liquid level marked, and labeled (Container #7).
- The back-half of the filter holder, probe, impingers, and connecting glassware were rinsed three times with methylene chloride (MeCl₂) into a separate amber glass container with a Teflon[®]-lined cap (Container #8).
- All containers were checked to ensure proper sealing, proper labeling, and that all liquid levels were marked.
- All samples were logged onto a chain-of-custody form.

The filter, front, and back-half rinses were used to determine PM concentrations. The impinger catches (impingers 1 thru 4) were also used to determine moisture and condensable material.

The samples were analyzed in accordance with the procedures presented in Section 5.1.1 of this test plan.

4.4.5 EPA Method 26 for HCl/HF

Hydrogen Chloride and Hydrogen Fluoride (HCl/HF) emissions were determined according to

EPA Method 26, "*Determination of Hydrogen Halide and Halogen Emissions from Stationary Sources Non-Isokinetic Method*" (40 CFR Part 60 Appendix A). Sampling consisted of three one-hour test runs for each TRONA on and TRONA off conditions.

The sampling train consisted of a heated probe and glass-liner. The sample gas passed through the heated probe assembly to a heated filter holder assembly containing a quartz fiber filter and a Teflon® frit support. Downstream of the heated filter, the sample gas passed through a series of five ice-cooled midge impingers kept below 68°F to enable condensation of entrained moisture. The first and second impingers each contained 15 mL of 0.1N H₂SO₄. The third and fourth impingers contained 15 mL of 0.1N NaOH. The fifth impinger contained silica gel. The impingers were followed by a dry gas meter, pump, and a calibrated orifice meter.

Sampling will be non-isokinetic and at a sampling rate of approximately 2 liters per minute. The readings of flue gas parameters were recorded every five minutes during the sampling period. A total sample gas volume of approximately 120 liters was collected.

Leak checks of the entire Method 26 sampling train were performed before and after each sampling run.

Following the completion of each test run, the Method 26 train was transported to the recovery area onsite. The recovery sequence proceeded as follows:

- Remove the sampling train to the recovery area.
- Note the condition of the train (i.e., filter condition, impinger contents color, silica gel color, etc.).
- Placed the contents of the first two impingers into a sample container (Container #1). Rinsed the impingers with deionized water and added the rinse to Container #1. The container was then be sealed, labeled and the liquid level marked.
- Placed the contents of the third and fourth impingers into a sample container (Container #2). Rinsed the impingers with deionized water and add the rinse to Container #2. Added sodium thiosulfate to Container #2 in the amount prescribed by Method 26. The container was then be sealed, labeled and the liquid level

marked.

The Method 26 train produced the following samples:

- Container No. 1 - Contents of Impingers 1 and 2
- Container No. 2 - Contents of Impingers 3 and 4

Additionally, reagent blanks for the deionized water, the 0.1N H₂SO₄ and the 0.1N NaOH were collected, logged onto the chain of custody form and submitted for analysis.

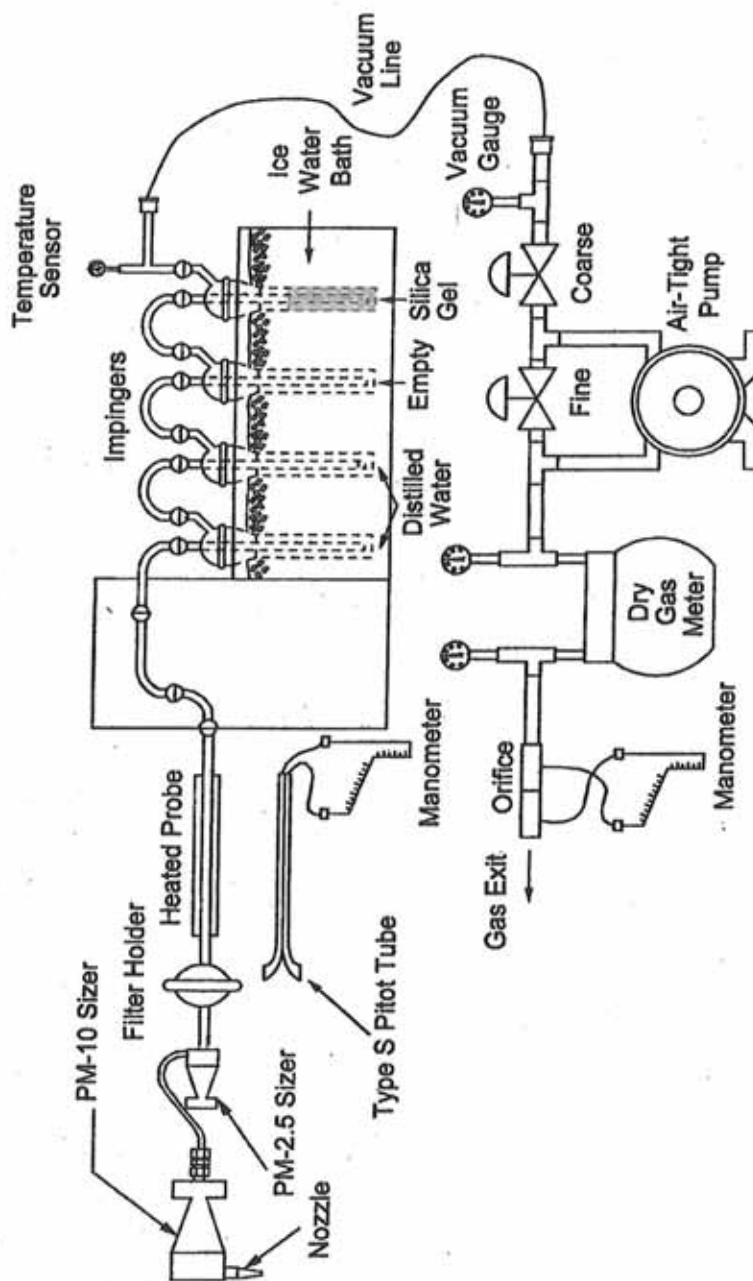


Figure 4-1. EPA CTM 040/202 Sampling Train

5.0 ANALYTICAL PROCEDURES AND CALCULATIONS

This section delineates the analytical procedures and calculations, which were used to analyze and report the sample results for this test program.

5.1 ANALYTICAL PROCEDURES

5.1.1 Particulate Matter

PM₁₀, PM_{2.5}, and Condensable sampling analysis were accomplished by following the procedures in EPA Methods CTM-040 and 202. The glass fiber filters were placed in glass petri dishes and desiccated to a constant weight. An identification label was placed on the petri dish. The containers used for the dry down of the acetone rinse were cleaned, dried in an oven at 250°F, and desiccated to a constant weight prior to use for analytical purposes.

The contents from Container Nos. 2, 3, 4 and 6 were air dried in a tared container and then desiccated and weighed to a constant weight. The filter was desiccated and weighed to constant weight. The sum of the net weights for the probe wash and filter catch were used to calculate the concentration of filterable particulate matter.

The contents of Container Nos. 7 and 8 were combined and extracted with MeCl to separate the organic and inorganic fractions. The organic fraction was desiccated and weighed to a constant weight. The inorganic fraction was analyzed in accordance with the method procedures (EPA Method 5F) for determination and correction of sulfate, chloride, and NH_4^+ contribution. The sum of the organic and inorganic fractions was reported as the total condensable particulate. The sum of the filterable and condensable particulate fractions has been reported as the total PM.

5.2 CALCULATIONS

5.2.1 Flowrates

Calculations for the determination of dry gas sampled at standard conditions (dscf), gas velocity at stack conditions (afpm), and gas volumetric flow rate at standard conditions (dscfm) were as follows.

5.2.1.1 *Volume of Dry Gas Sampled at Standard Conditions*

Volume of dry gas sampled at standard conditions, dscf^a

$$\text{dscf}^a = \frac{528 \times (Y) \times (VM) \times (PB + PM)}{29.92 \times (TM + 460)}$$

where:

^a	=	Dry standard cubic feet at 68°F (528°R) and 29.92 inches of Hg
Y	=	Dry gas meter calibration factor
VM	=	Sample gas Volume, ft ³
PB	=	Barometric Pressure
PM	=	Average Orifice Pressure Drop, inches of Hg
TM	=	Average Dry Gas Temperature at meter, °F

5.2.1.2 *Velocity of the Exhaust Gas*

Stack gas velocity at stack conditions were determined in terms of feet per minute(fpm)

$$\text{fpm} = 5130^c \times C_p \times SDE_{\text{avg}} \times \left[\frac{1}{PS \times MW} \right]^{1/2}$$

where:

^c	=	$5130 = \frac{85.5 \text{ ft}}{\text{sec}} \left[\frac{(\text{lb/lb - mole}) \times (\text{in. Hg})}{(^{\circ}\text{R}) \times (\text{in. H}_2\text{O})} \right] \times 60 \text{ sec/min}$
C _p	=	Pitot tube coefficient
SDE _{avg}	=	$(\sqrt{\Delta P})_{\text{avg}} \times \sqrt{\text{Stack Temp}_{\text{avg}} + 460}$
PS	=	Stack Pressure, absolute inches of Hg = Barometric Pressure ± Avg Stack Static Pressure

MW = Molecular Weight of Wet Stack Gas

5.2.1.3 Volumetric Flow Rate of the Exhaust Gas

Stack gas volumetric flow rate at standard conditions, dscfm^c

$$\text{dscfm}^c = \frac{\text{acfm} \times 528 \times \text{MD} \times \text{PS}}{(29.92) \times (\text{TS}_{\text{avg}} + 460)}$$

where:

^c = Dry standard cubic feet per minute at 68°F (528°R) and 29.92 in.Hg
acfm = Actual cubic feet per minute (fpm x cross sectional area of stack)
MD = Mole Fraction of Dry Gas (dimensionless)
PS = Stack Pressure, absolute, inches of Hg
TS_{avg} = Average Stack Temperature

5.2.2 Particulate Matter - Grains per Dry Standard Cubic Foot

Emission rates in terms of grains per dry standard cubic feet (gr/dscf) were calculated using the PM_{total} weight in terms of milligrams (mg) divided by the volume of gas collected (dscf).

$$\text{gr/dscf} = 0.0154 \times \left[\text{mg}(\text{total}) \div \left\{ \frac{528 \times (Y) \times (VM) \times (PB + PM)}{29.92 \times (TM + 460)} \right\} \right]$$

where:

mg_(total) = PM_{total}, filterable and condensable particulate
dscf = Dry standard cubic feet at 68°F (528°R) and 29.92 inches Hg
0.0154 = 0.0154 grains per milligram
Y = Dry gas meter calibration factor
VM = Volume metered, ft³
PB = Barometric Pressure, inches Hg
PM = Average Orifice Pressure Drop, inches Hg
TM = Average Dry Gas Temperature at Meter, °F

5.2.3 Particulate Matter – Pounds per Million BTU

Emission rates were calculated in units of pollutant mass per quantity of heat input (lbs/MMBtu). The emission rates were calculated using the particulate diluent concentrations and the default F-factor for coal (e.g., 9780) as specified in EPA Method 19. Measured PM emission concentrations were converted to a mass emission factor in terms of lbs/MMBtu using EPA Method 19, Equation 19-1:

$$PM_{total} \text{ (lbs/MMBtu)} = \frac{PM_{total} \text{ (gr/dscf)}}{7000 \text{ (gr/lb)}} \times F_d \text{ (dscf/MMBtu)} \times \frac{20.9}{20.9 - \% O_2 \text{ measured}}$$

where:

F_d = Ratio of the volume of dry effluent gas to the gross calorific value of the As-fired fuel. (Default F-factor for coal, in terms of dscf/MMBtu was used).

5.2.4 Particulate Matter – Pounds per Hour

Emission rates in terms of pounds per hour (lbs/hr) were calculated using the PM emission concentration in terms of grains per dry standard cubic foot (gr/dscf), the outlet stack flowrate Q_s (dscfm) and the emission factor of 7000 grains in a pound (gr/lb).

$$PM_{total} \text{ (lbs/hr)} = \frac{PM_{total} \text{ (gr/dscf)} \times Q_s \text{ (dscfm)} \times 60 \text{ min/hr}}{7000 \text{ gr/lb}}$$

5.2.5 Mass of Hydrogen Halides HCl and HF

The mass of the HCl and HF in the samples were calculated using the following equation:

$$M = K \times V_s (Sx^- - Bx^-)$$

Where:

M = Mass, ug
 K = K_{HCl} is 1.028
 K_{HF} is 1.053
 V = Volume of filtered and diluted sample, ml
 Sx^- = Analysis of sample of halide ion (Cl^- or F^-), ug/ml
 Bx^- = Mass concentration of solution blank for halide ion (Cl^- or F^-), ug/l

5.2.6 Concentrations of Hydrogen Halides HCl and HF

The concentrations of HCl and HF in the samples were calculated using the following equation:

$$C = \frac{M \times 10^{-3} \text{ mg/ug}}{V_m(\text{std})}$$

Where:

C = Concentration of HCl or HF, mg/dscm
V_m(std)= Dry Gas Volume Measured, Standard

5.2.7 HCl and HF – Pounds per Million BTU

Emission rates were calculated in units of pollutant mass per quantity of heat input (lbs/MMBtu). The emission rates were calculated using the HCl and HF diluent concentrations and the default F-factor for coal (e.g., 9780). Measured HCl and HF emission concentrations were converted to a mass emission factor in terms of lbs/MMBtu using the following equation:

$$\text{HCl/HF (lbs/MMBtu)} = \frac{0.0154}{7000 \text{ (gr/lb)}} \times F_d \text{ (dscf/MMBtu)} \times \frac{20.9}{20.9 - \% \text{ O}_2 \text{ measured}}$$

where:

0.0154 = Conversion factor to convert mg/dscf to gr/dscf
F_d = Ratio of the volume of dry effluent gas to the gross calorific value of the As-fired fuel. (Default F-factor for coal in terms of dscf/MMBtu was used).

6.0 QUALITY ASSURANCE

6.1 OVERVIEW

TRC Environmental Corporation management is fully committed to an effective Quality Assurance/Quality Control Program whose objective is the delivery of a quality product. For much of TRC's work, that product is data resulting from field measurements, sampling and analysis activities, engineering assessments, and the analysis of gathered data for planning purposes. The Quality Assurance Program works to provide complete, precise, accurate, representative data in a timely manner for each project, considering both the project's needs and budget constraints.

This section highlights the specific QA/QC procedures followed for this Test Program.

6.2 FIELD QUALITY CONTROL SUMMARY

6.2.1 Calibration Procedures

Calibration of the field sampling equipment was performed prior to the field sampling effort. Copies of the calibration sheets were submitted to the field team leader to take onsite and placed into the project file. Calibrations were performed as described in the EPA publications "*Quality Assurance Handbook for Air Pollution Measurement Systems; Volume III - Stationary Source Specific Methods*" and EPA 40 CFR Part 60 Appendix A. Equipment calibrated included the sample metering system, nozzles, barometers, thermocouples, and Pitot tubes. All calibrations were available for review during the test program. Copies of the equipment calibration forms are be found in Appendix E.

6.2.2 Equipment Leak Checks

Prior to sampling, each sampling train was leak checked according to the procedures outlined in

EPA Reference Method 5. Final leak checks were performed to ensure that no leaks developed in the train during the course of each test run. All leakage rates, if any found, were recorded on the appropriate field data sheet.

6.2.3 Calibration Gases

All calibration gases used to conduct instrument calibrations were prepared in accordance with the EPA Protocol 1.

6.2.4 Cyclonic Flow Check

The absence of cyclonic flow within the outlet stack was established prior to sampling, in accordance with Section 2.4 of EPA Method 1.

6.2.5 Method Blanks

One Method blank for the CTM 040/202 sampling train was taken during the field-sampling program to ensure sample quality.

6.3 SAMPLE CHAIN OF CUSTODY

The chain-of-custody of the samples were initiated and maintained as follows:

- Each sample was collected, labeled, sealed, and the liquid level marked on appropriate samples.
- The sample was recorded on the sample chain-of-custody form.
- Custody of the samples was retained by TRC until delivery to the analytical laboratory for analysis.

6.4 DATA REDUCTION, VALIDATION, AND REPORTING

Specific QC measures were used to ensure the generation of reliable data from sampling and analysis activities. Proper collection and organization of accurate information followed by clear and concise reporting of the data is a primary goal in all projects.

6.4.1 Field Data Reduction

The Field Team Leader and at least one other field crewmember reviewed the data collected in the field. Any recording errors or discrepancies were noted on the field data sheet. Copies of all field data sheets have been included with the final report.

6.4.2 Laboratory Analysis Data Reduction

Analytical results were reduced to concentration units specified by the analytical procedures, using the equations provided in the analytical procedures.

6.4.3 Data Validation

TRC supervisory and QC personnel used validation methods and criteria appropriate to the type of data and the purpose of the measurement. Records of all data were maintained, including any judged to be an "outlying" or spurious value. The persons who validated the data have sufficient knowledge of the technical work to identify questionable values.

The Field Team Leader and/or the Field QC Coordinator based on their review of the adherence to an approved sampling protocol and written sample collection procedure validated field-sampling data.

Analytical data was validated using criteria outlined below. TRC utilized results from the field method blank to further validate analytical results. Furthermore, TRC reviewed all laboratory raw analytical data to verify calculated results presented.

The following criteria were used to evaluate the field sampling data:

- Use of approved test procedures;
- Proper operation of the process being tested;
- Use of properly operating and calibrated equipment;
- Leak checks conducted before and after tests;
- Use of reagents conforming to QC specified criteria;
- Proper chain-of-custody maintained.

The criteria listed below were used to evaluate the analytical data:

- Use of approved analytical procedures;
- Use of properly operating and calibrated instrumentation;
- Results of Reagent and Method Blanks.

6.4.4 Data Reporting

All data has been reported in standard units depending on the measurement and the ultimate use of the data. The bulk of the data was computer processed and has been reported using Excel as follows:

- Exhaust Gas Stream
 - Gas Properties:
 - a. Moisture, dscf and percent by volume
 - b. Flow rate, dscfm and acfm
 - c. Pressure, mm of Hg
 - d. Temperature, °F
 - Particulate:
 - a. gr/dscf and lbs/MMBtu
 - HCl:
 - a. mg/dscf and mg/dscm
 - Gas Diluents
 - a. O₂, percent
 - b. CO₂, percent

APPENDIX A
FIELD SAMPLING DATA SHEETS

APPENDIX A.1

UNIT 2

FIELD SAMPLING DATA SHEETS

APPENDIX A.2
UNIT 2
CEMS DATA

APPENDIX A.3

UNIT 3

FIELD SAMPLING DATA SHEETS

APPENDIX A.3.1
UNIT 3 – TRONA ON
FIELD SAMPLING DATA SHEETS

APPENDIX A.3.2
UNIT 3 – TRONA OFF
FIELD SAMPLING DATA SHEETS

APPENDIX A.4
UNIT 3
CEMS DATA

APPENDIX B
FIELD REDUCED DATA

APPENDIX B.1

UNIT 2

FIELD REDUCED DATA

APPENDIX B.2

UNIT 3

FIELD REDUCED DATA

APPENDIX B.2.1
UNIT 3 – TRONA ON
FIELD REDUCED DATA

APPENDIX B.2.2
UNIT 3 – TRONA OFF
FIELD REDUCED DATA

APPENDIX C
FACILITY PROCESS DATA

APPENDIX C.1

UNIT 2

FACILITY PROCESS DATA

APPENDIX C.2

UNIT 3

FACILITY PROCESS DATA

APPENDIX C.3

UNIT 3

FACILITY PROCESS DATA

FOR HCl/HF TESTS

APPENDIX D
LABORATORY ANALYTICAL DATA

APPENDIX E
EQUIPMENT CALIBRATION DATA SHEETS